LECTURES NATURAL PHILOSOPHY,

DESIGNED.

As a foundation, to reason pertinently,

PETRIFICATIONS, GEMS, CRYSTALS
AND

SANATIVE QUALITY

Lough NEAGH in IRELAND.

To which is added,

The MASTER-PIECE of NATURE,
Or, a short description of a

Beautiful LAKE near KILLARNY,
INTHE

County of KERRY.

By the Author of the ANALOGY of DIVINE WISDOM, in the Material, Sensitive, Moral, Civil, and Spiritual System of Things.

Naturæ opera, non prodigia consectamur. Plin. Nat. Hist. Lib. 7.

Desine quapropter novitate exterritus ipsa

Exspuere ex animo rationem; sed magis acri

Judicio perpende; et si tibi vera videtur,

Dede manus. Lucretius, Lib. 1.

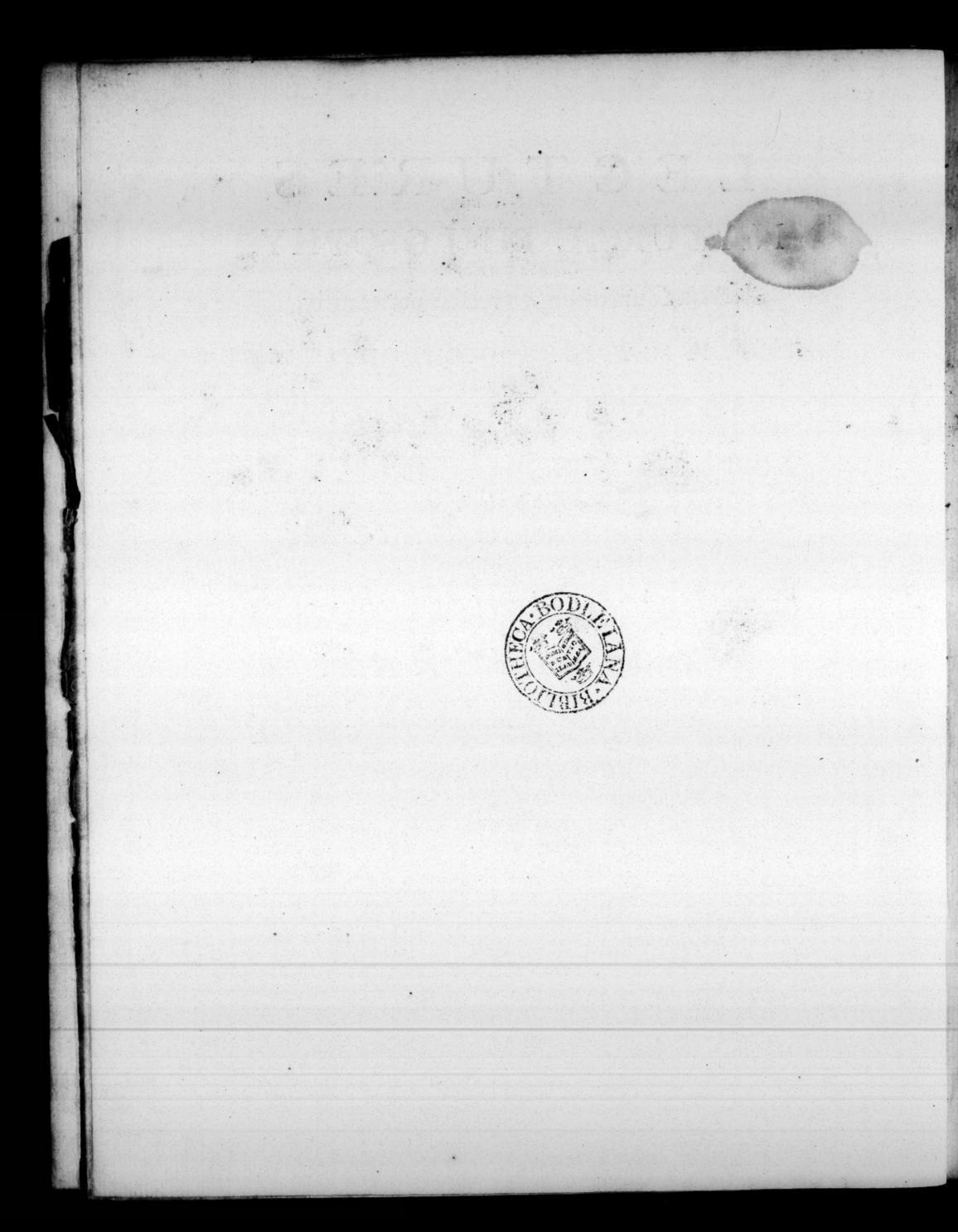
Sumptus impendimus, et pro instrumentis et pro libris, itineribus, tempori non parcimus, sudores profundimus, vires ipsas exhaurimus, ut D E I Creatoris, et Conservatoris, ubique conspicua gloria celebretur, et veritas ex D E I sinu emanans protrahatur in Lucem.

Schuitzeri iter Alpinum octavum

Lug. Bat. 1723.

DUBLIN:

Printed for the Author, by A. Reilly, and fold by George and Alexander Ewing, at the Angel and Bible in Dame street. M,DCC,LI.



TO THE LEARNED

UNIVERSITIES

OF

GREAT-BRITAIN,

AND

I R E L A N D;

And to the LEARNED and INQUISITIVE MEMBERS of the Royal Society, these LECTURES are most humbly dedicated.

GENTLEMEN,

Ovelty being that which principally pleases, these Lectures may at least convey one circumstance of Delight. It is several Centuries since Mankind spoke of the subjects of them with admiration; it is half a century since the Learned inquired diligently concerning them; and it is but six years, since the Phænomena were fairly discovered, to the general conviction of Observers: The Author claims no merit in any respect, but that of a diligent Inquirer, and faithful Relator. His own reasoning he offers with all humility, not to prevent, but to excite better reasoning from you.

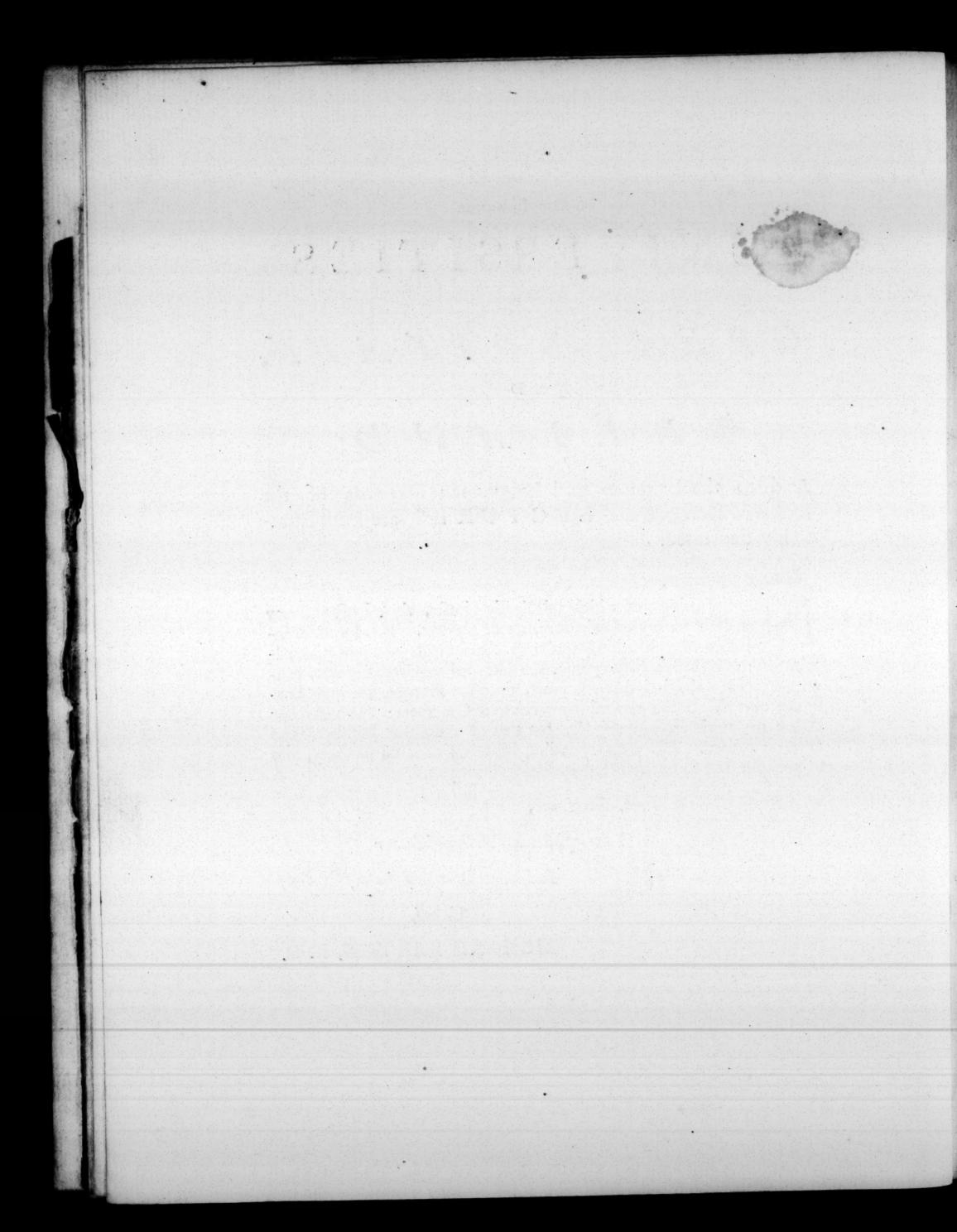
I am, Gentlemen,

Your affectionate Fellow-labourer

In Literature and Religion,

As United,

RICHARD BARTON, B. D.



AUTHOR

His friendly A D D R E S S

TO HIS

COUNTRYMEN.

T is with pleasure this writer observes, a most excellent spirit, arifing in this Kingdom, along with increasing opulence, to improve human nature. The magnificence of some habitations, the furniture of others, and the tables of them all, if they should rather prove the luxury and wealth of the nation, yet are they also proofs of the former. Luxury grows up along with arts and sciences. The Augustin age produced very great Geniuses in the latter respect, as well as very corrupt Examples in the former: And every other age, wherein wealth abounds, whether in a Christian or a Pagan state, will produce the same seeming contradictory effects, till a more general spirit of reformation prevails. For the moral dispositions of Mankind are extremely different, from those which go under the title of INGENIOUS; and the improvement of the latter does by no means include the former. The Ingenious immoral man only differs from the basely vitious, by becoming more exquisite in his pleasures; And Lucretius, almost the finest of poets, differs only from a gross blasphemer in the delicacy of his language and fancy. If Apicius taught a Roman to make a better fauce, he did not thereby teach him to be more temperate. If Horace, whose writings are become the BIBLE of the age, paints his own cowardice (relict à non bene parmulà) with WIT that makes the reader forget Censure, he has not thereby inculcated the virtue of Courage; or if his fine address to CESAR and MECENAS inchants the car, the heart is not thereby taught that resolute VIRTUE, which should make a man steady to an honest cause, in which he has once engaged,

and ever ashamed to relinquish it, upon the poor motive of dictating to School-Boys, that vitious Theme of flattery;

Principibus placuisse viris &c.

The improvement therefore of human nature in *ingenuity* is a very different confideration, from the more excellent improvement of it in (a) MORAL CONDUCT. This writer, not knowing, when the last excellent disposition to improve Mankind in pure morals will arise, yet always wishing for it, and hoping this is a good preparatory season, is willing to congratulate with his COUNTRYMEN even upon the former: And having lately laid before them part of his labours in the last respect, is willing also to compliment them with some of his labours in the first; In as much as delicate pleasures are as much preferable to choquing VICE, as refined satyr is to scurrility.

In this way of confidering things he is contented to act as a philosopher: And hoping to procure the esteem of his countrymen in this, he may perhaps afterwards come forth again in the other more Honourable Character of a Divine, to which his studies are principally devoted by Vow and Inclination. With this view he is willing to help them for some time as far as lies within his skill, to Build, and Plant, and Taste their Wines; or to dig with them,

in the bowels of the earth, for the hidden treasures of nature.

As a small specimen of this disposition he offers this book, being the effect of Six years inquiry, much bodily and mental labour, as well as pecuniary expence. Mechanic arts are every day improving in Ireland, and the liberal arts, it is hoped, will keep pace with them (b). The true way to give encouragement to the latter,

(a) The more people there are in a nation who stand in need of address amongst themselves, and caution not to displease, there will be the more politeness: but it is more a politeness of morals, than manners, which ought to distinguish us from a barbarous people.

De l'espirit des Loix.

15

(b) This book is printed upon paper made in Ireland; with types and gravings also of

the artificers of the country.

A late writer has complimented Ireland in a genteel manner, and it is hoped, the spirit of improvement continuing may give others occasion to speak praise-worthy things of it; and if its inhabitants should not think as honourably of themselves, as that gentleman has express himself of them, their modesty will not deduct any thing at all from their merit, if they have it in the degree mentioned.

"IRE LAND

is to invite those of thought, attention, and activity, to appear gracefully in public, by treating with humanity and generosity, what as writers,

they offer with humility and affection.

It is hoped the reader will not think himself detained too long from the principal subject of this book, if some objections to subscribing to books, be considered and answered; seeing it is by that method this book is introduced into the world, and without it the liberal arts can not easily be improved in this Kingdom. There are two forts of editors, authors, and booksellers: The Inquirer apprehends the booksellers are able to answer for themselves, and as an author, he thinks himself obliged to answer for authors, although it should seem needless, in a nation, which is only beginning to print its own literary productions, in its own cities, and where it is not known that any price is given to an author for his manuscripts. Yet upon account of some extraordinary cavillers, who suggest even before fact or experiment, objections

"IREL AND, Britain's younger fifter, seemeth to have useful and ornamental arts:

Yet Ireland, at thesame time, doth not want scholars, orators, poets, or philosophers. The sciences and arts, when they once become acquainted, are extreme good friends: they love, promote, and heighten each other: Were the experiment to be made here, a man would run no great risk in becoming accountable for the consequence. And should we not be displeased, as a nation, to be ranked by foreigners after one of our own colomies?

The same writer remarks of his own country, its inferiority to France in one particular respect, wherein he is pleased to say Ireland has got the start; and expresses himself strongly. "Shall we not be fired with emulation to rival these neighbours, who are our construed enemies in politics, while they triumph over us in their regular method of introduction to the arts? It has been said, that England is a century behind France in learning, and politeness. I have proved that this affertion does not in general hold good; but it is punctually true, with regard to an institution of the nature we are pleading for." To wit an academy for painting, sculpture and architecture. J. Gwyn, Essay on Design;

It is wished Ireland would consider, how much reason there is to be affected with the contempts thrown upon it: Notwithstanding the praise this gentleman has bestowed out of a good intention to spirit up his own countrymen, the IRISH should act as those who had not yet a title to or possession of praise, but in the way to deserve and obtain it.

which should be founded upon them; short answers shall be given to the most common.

One thing should be previously remark'd, that whatever weight the objections to subscribing to the printing of books may have in regard to authors, the mechanical arts of printing, graving, and the manufactures belonging to them, should be encouraged: So that the printing even of a senseless book, is, in these respects, rather a benefit than an injury to the public: But at present the case of an author in respect to subscriptions, shall be principally considered; and particularly that of an author, who is only entering into the world, and has a public reputation to acquire: For those of established same do not often stand in need of the method of publication by subscription.

A fubscriber has a very just right, to compute paper and ink, comparatively with the sum demanded, when a subscription is asked for a book already published. But when an author publishes his own original work, there should be an allowance for him, in that character, over and above what might be asked in the other respect. If this be not allowed to be reasonable, a very great discouragement is thrown upon ingenuity and pains taking; and literature must suffer exceedingly by it. How therefore can any gentleman justify a resolution never to subscribe to any book? For there are some imprudent enough

to declare this injudicious, perhaps avaritious resolution.

Is it because they have been sometimes imposed upon by editors, in the delay of the works promised, or perhaps in the not performing at all what was promised, or in the unworthiness of the performance? Or is it because the persons sollicited to subscribe are ig-

norant? (c)

As to delay, the objection is light; the work is better thereby. And furely the interest of money subscribed for books, is hardly worth computing; and if it be, the better execution of the work is a sufficient compensation. Perhaps the delays are owing to the want of generosity in those, before whom proposals are laid, and not to the author; or to some intervening events inscrutable to human wit; which should always be a sufficient apology.

As

⁽c) Some persons are not ashamed to own their ignorance of what it would be their Glory to know, and even to charge others with it, rather than part with a small sum to encourage liberal arts.

As to a non-performance of promise to the public; perhaps this may be owing in some cases to one cause of the former, to wit, events impossible to be foreseen: If to dishonesty, the author means not to apologize: A writer should at least have the common quality indispensible in all dealers, a disposition to act upon the square: But since bank-rupcy avowedly fraudulent, does not destroy the reasonable considence due to honesty, and the merchant still gives credit to the fair dealer, so should it be in this case.

As to the unworthiness of the performance, upon which it is likely the objectors lay a great stress, it is as weak as any of them. For shall a man resolve never to give alms, because being sometimes deceived, he has given to unworthy objects? As no one, but an uncharitable person, can make this resolution; so no one, but a discourager of literature, can resolve never to subscribe to the printing of any book.

Besides, gentlemen should take care how they hazard the discouraging of any one, who may have extraordinary talents (d) in a nation, by not encouraging many persons, who have them in an ordinary proportion. Reputation is a sufficient bar to all adventurers in print, who are not abandoned; and an author must be a known prostitute, before such a character can be given of him without injustice. The sense of reputation which is inseparable from human nature, till it becomes extremely vitiated, should be a sufficient reason for presumption, that there is some soundation for worth in the performance.

As to ignorance, which some persons more bold than prudent charge to many orders of men; the Inquirer owns, that he has heard almost five hundred times, that there are only five hundred Readers in Ireland. He does not know upon what methods of information this is afferted (e); but it is plain,

(d) It is faid that Sir Walter Raleigh and Doctor Cudworth, burned a great part of their valuable writings, upon account of the ill grounded contempt of the world to what they published. How dearly would the discerning part of Mankind purchase these writings now, could they be purchased?

(e) Perhaps their information is taken from bookfellers, who say, they rarely sell more than five hundred copies of the best books. The Inquirer can assure the reader, that he disposed of one thousand books of the Analogy of Divine Wisdom, (in the material, sensitive, moral and spiritual system of things,) the intirely a book of religion, which is not the most palatable subject of this age; and he hears that a book giving an account of Lord A—n's voyage, was only sold to the number of two thousand, in which there was not one word of religion, not the name of God or Divine Providence, yet abounding with deliverances almost miraculous.

plain, there ought to be a great many more, if all the orders of literary professions be computed. Let any one consider the number of Lords, Commons, Clergy, Judges, Lawyers, Physicians, the Members of an University, consisting of five hundred persons, and the officers of a standing army of twelve thousand men, with many persons of wealth and education, not belonging to any of these orders, and then ask the question; how many reading men amongst all those? If the answer could be consistent with truth, only five hundred; would it not be proper to ask? Are laws made with judgment, or expounded with skill? Is religion supported with learning, and christianity inforced with authority and strength of reasoning? And is the practice of medicine in repute? And how do the gentlemen of the army spend their time in barracs; and many persons their lives of ease and retirement, having wealth by inheritance? *

Let these questions be answered by others. For notwithstanding that strange opinion, which it is hoped, has no soundation, the Inquirer upon a presumption that there are many readers in Ireland, and encouragers of literature, and out of a real affection to his country, is an adventurer in print. He offers with all humility and deserence some of his philosophic labours to the public, assuring the learned and humane reader, that he does not mean to impose upon him either common phænomena or common reasoning, but something of novelty in in the latter, as well as the former; yet he hopes with such strength of argumentation, as may be the soundation of a correct judgment, and may merit rather the thanks of the courteous reader, than contempt. However, if the latter should be the consequence, he may at least comfort himself with the consciousness of a well meaning design, and a share in the glory of the motto, in magnis voluise sates.

For to attempt to rescue a country from unmerited disgrace by the pen, is no less glorious, than to engage in its deliverance from slavery, by the sword. It is to be wished that this was the sentiment of every

writer:

(f) See an account of printing in Ireland, sent from thence to Joseph Ames, F. R. S.

1749.

^{*} There is a great occasion to speak here of avarice, but that rather belongs to preaching. Poverty also deserves a consideration, in respect to some men of letters; but although sometimes brought voluntarily upon them, it excites pity, rather than censure. The circumstances of such persons is very unpleasant, who cannot do a small act of generosity to the community, without an act of injustice to their families.

writer of this country: But he, who gave the last account of printing, says, They that value their reputation, commonly send their writings to England to be printed (f). It would seem vain to express an emulation with England for liberal arts; but however unequal the comparison would be, it could not be liable to any bad consequence, the very principle of emulation being an excellent spur to all things praise-worthy: Newton and Leibnitz were emulous to the advantage of mankind.

The Sun need not be jealous of the stars, till they increase in lustre, and come nearer to an equality of visible magnitude and splendor; and our generous neighbours cannot, but with pleasure see us, even attempt to imitate their best works; and if a little concern be exprest for the disposition amongst us, to send almost all our reputable works to their large Shop of reputation, they will allow it to be an affection that is not culpable, to wish well to the credit of a native soil. How fmall a proportion does the number of preachers of religion in Ireland, bear to those of Great-Britain; those of the church by law established, being only twelve hundred, including CURATES, who are deferving of a place in all arithmetic concerning religion and literature, in this island; fince their labours contribute greatly to the support of both, in the characters of school-masters and authors, as well as curates. How small a proportion does its University, consisting of five hundred perfons, and in proportion, all orders of men in the kingdom (the whole being perhaps as two millions to ten) bear to all the Universities of Great-Britain, and to all orders of men in that extensive, ingenious, industrious, opulent island. It is not therefore likely that the utmost efforts of Ireland, in the Liberal Arts can excite an injurious jealously.

The Inquirer was not without encouragement to print in England, having invitations from some very good patrons of literature, some of whom have interest in a large University, and some in a Royal Society, whose reputation is acknowledged, wherever insensate nature affords B 2

⁽g) The author being a considerable distance from the place where most of his papers lie, cannot here give a copy of the letter mention'd, but having another from the same excellent person extremely polite, and to the purpose of this design, he takes liberty to publish it.

S I R,

Ormond-street, April 27, 1750.

Received from Messieurs Knapton, the copies of your excellent book of Divine Analogy, &c. I paid him for six, and read it with a great deal of pleasure. I have now your proposals

phænomena, and human nature studies them. If among these one gentleman be particularly named, it is hoped, he will not be displeased, and certainly the reader can not but be pleased. The learned Doctor MEAD did generously promise by letter (g), to publish the materials of this book to the best advantage for the author. This is here taken notice of, as well to acknowledge the high regard he bears to these eminent patrons of literature, as to give him some title to estimation in his own country, for at least seeming to wish himself honour in it, although invited to fearch for it elsewhere, by those, who were able to give it. As a confirmation of which he adjoins a copy of a letter from the University of Cambridge, in answer to one of his, being an acknowledgment of a pre-

proposals for printing Lectures in Natural Philosophy. I make no question, but this book will afford me the same satisfaction with the former. I desire you will put me down a fubscriber for fix copies; I wish you most heartily all manner of happiness and success, in your useful undertakings, &c.

The Inquirer thinks it a respect due to the University where he was bred, not to omit expressions of good wishes to so learned a body, and which being contained in two letters, he will lay one of them before the reader.

Illustri Academiæ Dubliniensi R. Bartonus The. Bac. S. P. D.

HAud ita pridem ad vos misi miraculi Lacus Neachi insigne specimen. Miraculum quidem, non quia contra naturæ leges aliquid exhibetur, sed quia phænomenon, etiamsi legibus naturæ consonum, rarum & mirandum. Quoniam nuper mihi contigit invenire plura hujuscemodi speciosa specimina; horum esse participes vos precipúe dignamini; apud quos Philosophia Newtoniana, qua intima naturæ arcana referantur, colitur. Hæc (quicquid cogitat vulgus philosophorum) per naturæ labyrinthum, per vias flexuosas velut filo discipulos ducit: Ita vos me docuistis, ita credo, vester amantissimus alumnus. Hæc igitur attractionis miranda specimina vobis non ingrata fore confido: Grato saltem erga vos & studia vestra amori meo hæc pufilla dona tribuetis. Si alumni vestri singuli vel tantulum colligerent, in quantum cumulum brevi accreverit philosophica materia. Modo doctorum inventis, modo philosphiæ Newtonianæ, modo veritati, per hæc nostra siat aliqua accessio, pro munere habebo.

Non animus est vos longâ morari epistolâ; breviter narrabo: Quod nuper dono dedi*, insigne erat specimen ligni superficiei lapidis adhærentis & continui. Ni fallor (et sensus bene dispositi non fallunt) quod nune offertur, lignum intime complectitur tanquam medullam lapidis; adeo ut tenera ligni materia duro lapide circumsepta quasi munitur. Lapis, cujus exhibetur vobis fragmentum, viginti erat pondo.

BENE VALETE.

Datum Lurgano, Sept. 18, 1745.

This has reference to a former present made.

2 present of natural rarities sent some time before. Besides, as that letter contains many curious inquiries, which this book is designed to answer, it is expedient to publish it; and as his honourable sentiments of that University, were express in his own letter, which are heightened by the kind acceptance and acknowledgment of his present, he desires the favour of the courteous reader, to indulge him the liberty to lay that letter also before him.

Inclytæ Academiæ Cantabrigiensi R. Bartonus, S. P. D.

Uibus fama Lacus Neachi in Hiberniâ non est ignota, specimina petrificationis miranda forsan non erunt ingrata. Diu est agitata quæstio, utrum lignum queat in lapidem durescere? En massæ ingentis fragmina, in quibus lapis est ligno continuus, tam in corde quam in super-Quo modo autem hoc fit, vestrum est explicare. Natura miraculorum ubique ferax est, prout unumquodque phænomenon digito velut Dei nobis indicatur. Ille materiam format deformatque legibus, quas ipse imposuit materiæ primordiis rerum. Quisquis harum incumbit studio philosophus evadit, imo theologus, & quo plures noverit leges co magis sophus: Catenam earum mirandam suspicit, & qui sustinet catenam adorat Deum. Dei omnia plena. Sive moveat, sive quiescat materia, sive attrahant sive repellant sele ejus particulæ; et motus & quies non nisi ex Deo sunt. Ita nos docuit philosophia Newtoniana, ita vos docetis, eximii ejus cultores. Hæc rara & hermaphroditea cohæsionis specimina accipiatis velim, teltimonium æltimationis meæ erga vos, doctiffimi viri. Ignotus ad bene notos scribo. Quorum scripta leguntur, ipli non celantur; quorum libri in bibliothecis reconditi doctorum manibus teruntur; eorum fama per hominum ora volitat. Si hoc pufillum donum vel tantulum conterat literis promovendis, vel mentem dubitantis figat, vel amorem erga notitiam rerum naturalium excitet, nihil aliud quæritur; Macte igitur studiis este, beneque valete.

Datum Lurgano, in Comitatu Ardmacano, in Hiberniâ.

Octob. 2, 1745.

X111

VIR REVERENDE,

TNteger jam mensis abiit ex quo tuam epistolam mecum communicavit L Vicecancellarius noster, ut tam suo quam præfectorum collegiorum et totius lenatus academici nomine ad te rescribere, gratiasque quam maximas agere velim. Hoc munus in me lubenter lulcepi: Quamvis enim tuam erga academiam, erga literas & philosophiam veriorem benevolentiam studiumque agnoscerent omnes, et collaudarent, quibus doni tui utilitas satis perspecta non esset; mihi vero præcipuè cordi fuit, diu speratis tandem frui exemplaribus, alibi forsan quam inter vos Hibernos frustra quærendis. Haud rara ligni petrificati specimina præbet Anglia nostra, quorum plurima vidi, nonnulla nactus sum: Talia autem funt eorum nonnulla, ut quibuldam suspicionem haud immerito possint injicere, eadem vera ligna nunquam fuille. Alia reperi iple, led rarissima hæc, vera adhuc ligna saxo licet undique inclusa.——Tua autem exemplaria, cum ejusdem pars una sit adhuc lignum a statu naturali parum recedens, cum interea pars reliqua sit omnino in lapidem conversa, omnem dubitandi ansam etiam ab invitis prorsus extorquent. Testimonium omnibus mulæum Woodwardanum per aliquot forlan fæcula viluris præbitura.

Responsum diutius distuli, ut de reliquis exemplaribus nonnihil adnotarem: Cum vero quò minus commodè hoc sieri poterat, valetudo parum sirma prohibuerit, neque limites epistolæ multa de iis dicenda admitterent; susius forsan olim, si tibi libet, tecum acturus, nolui ulterius responsum procrastinare, quo certior esse poteras dona tua ad nos

salva venisse.

Hoc interea te, Vir Reverende, rogatum velim, utrum vel ex tuis vel aliorum fide dignorum observationibus certè constare possit, saxea hæc ligna non aliquando sub terra latuisse, & ex diuturno aquarum motu, exeso strato ambiente, in aquas tandem delapsa suisse; ut enim verum satear, vix animum meum inducere possum, ut credam aquæ soli hanc vim inesse.

Quod si partes non petrificatæ aquæ aut molliori luto suerint expositæ, cum interea partes reliquæ sabulo vel arena tegerentur, unde suam duritiem nanciscerentur? Conjecturæ veniam dabis, quæ an vera sit ex multis

The:

multis datâ operà factis, & inter se collatis observationibus solummodo determinari potest; quales si sactæ unquam suerant lubenter scire cupit, tibi jamjudum divinctissimus.

CAROLUS MASONUS.

Dabam 17 Kal. Jan. 1746.

Ex Collegio Sanctæ Trinitatis, in quo studebant Baconus & Newtonus.

To the foreign testimonies in favour of the subject matter of the work may be added the celebrated names of Mr. Molyneux, Lhuyd, and others mentioned in the transactions of the Royal Society, as persons deputed by that honorable Body to inquire into these things. Their sentiments being printed, the reader may have recourse to them, wherein he will find an acknowledgment of their having failed of success in their searches. How far the Inquirer, who now offers his book to the public, upon the same subject, has succeeded, and what degree of esteem his success may deserve, the reader is just upon the point of determining; who shall have no surther interruption from him, than that of acquainting him, that this is a discharge of an obligation, to which the Inquirer was in some degree bound, by the promise of another gentleman, as appears from the following extract from the philosophical transactions for the year 1746.

A letter from Mr. James Simon, of Dublin, to Martin Folkes Efq;. Pr. R. S. concerning the Petrifications of Lough Neagh, in Ireland.

I Received last Summer 1745, from my worthy and ingenious friend, the Rev. Mr. Richard Barton, about 30 of these stones, sound on the shores of the lake, some in the water, some in the mud, some in the sand, others in a yellowish clay, &c.——The curious gentleman above mentioned, who hath already begun, and intends, at his leisure, to take an accurate survey of the lake, will, I hope be able to give a more just and satisfactory account of its petrifying virtue, than I possibly can; my design in the present attempt, being only to pave the way, and induce others to make farther experiments in search of truth, and for improving natural knowledge.

The Inquirer offers his book to the public, not as a full discharge of that ingenious gentleman's promise on his behalf, but only in the same manner in which he speaks of his own attempt, TO PAVE THE WAY, AND INDUCE OTHERS TO MAKE FURTHER EXPERIMENTS IN SEARCH OF TRUTH, AND FOR IMPROVING NATURAL KNOW-LEDGE, to which shall be added one circumstance, so FAR AS THAT KNOWLEDGE IS THE HANDMAID OF RELIGION, AND CLOSELY ATTENDANT UPON IT:

If the execution of the reasoning part of this work be deemed a specimen of any degree of credit, to the liberal arts in Ireland, as the subject matter is of the materials which this island can afford to the natural philosopher; and as the type, paper, and gravings * are of the mechanic arts; and if others are hereby invited to promote the honour of Ireland in all reputable respects, NATURAL, MECHANIC MERCANTILE, and LITERARY, The editor's ambition is answered; as well as the benevolent wishes of all those worthy persons, whose names are printed; to whom the editor returns his cordial thanks for joining with him in so laudable a DESIGN.

^{*} The frontispiece of this book was painted by a very ingenious Lady, almost from a verbal description, and yet her pencil has come so near NATURE, that had she drawn from it, would it be vain to have expected, that she would have excelled it?

L I S T

Of the NAMES of

SUBSCRIBERS,

To LECTURES in Natural Philosophy, designed to be a foundation for reasoning pertinently, upon the Petrifications, Gems, Crystals, and Sanative Quality of Lough Neagh in Ireland; intended also to be an introduction to the Natural History of several Counties contiguous to the Lake, particularly the County of Ardmagh.

N. B. Denotes the writing medium paper. The names printed without a mark, are those who subscribed for the printing medium paper. Numeral figures

annext denote the number of books subscribed for.

An. denotes the person to whose name it is annext, to have been also a subscriber to a book of The Analogy of Divine Wisdom, in the Material, Sensitive, Moral, Civil, and Spiritual System of Things; published last year in Dublin, whose names, for reasons assigned in the conclusion of that book, were not then printed.

SUBSCRIBERS.

His Excellency, WILLIAM STANHOPE, Earl of Harrington, late Lord Lieutenant General, and General Governor of Ireland *.

His Grace Doctor GEORGE STONE, Archbishop of Ardmagh, Primate and Metropolitan of all Ireland, and one of their Excellencies the Lords Justices of this Kingdom * 6 An.

ROBERT Lord Newport of Newport, Lord High Chancellor of Ireland, and one of their Excellencies the Lords Justices of Ireland *

A.

A.

Ntrim, Rt. Hon. Earl of • An.

Achefon, Sir Archebold, * An.

Achefon, Capt. Arthur, * An.

Adair, Robert, Efq; *

Alcock, Rev. Alexander, A. M. *

Anderson, John, M. D.

Anketel, Oliver, Efq; jun.
Antrobus, Rev. George, A. M. *
Afhe, Mr. Jonathan, Merchant.
Armstrong, John, Efq;
Atkins, Rev. John Thomas, *
Atkins, Mrs. Barbara

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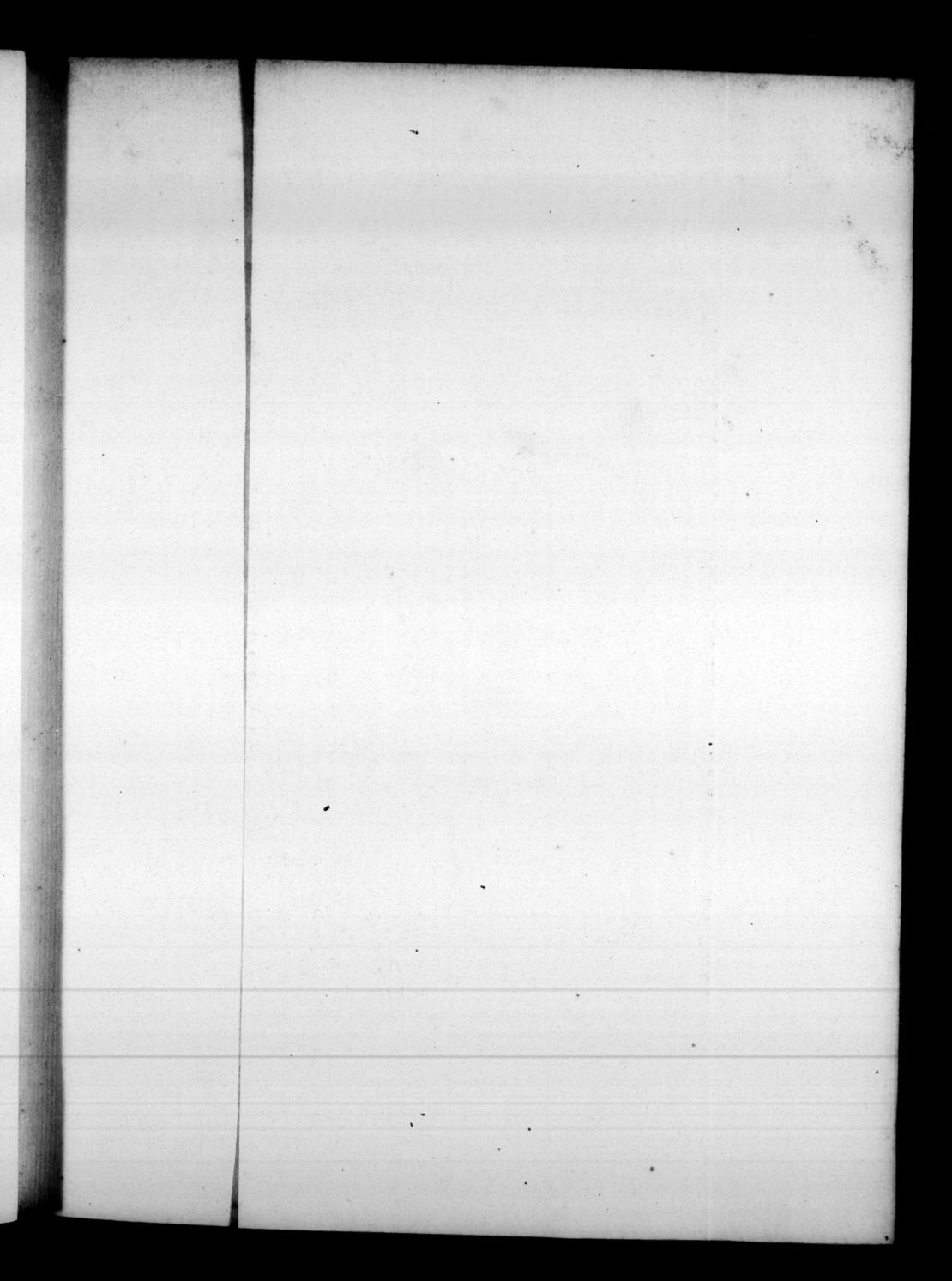
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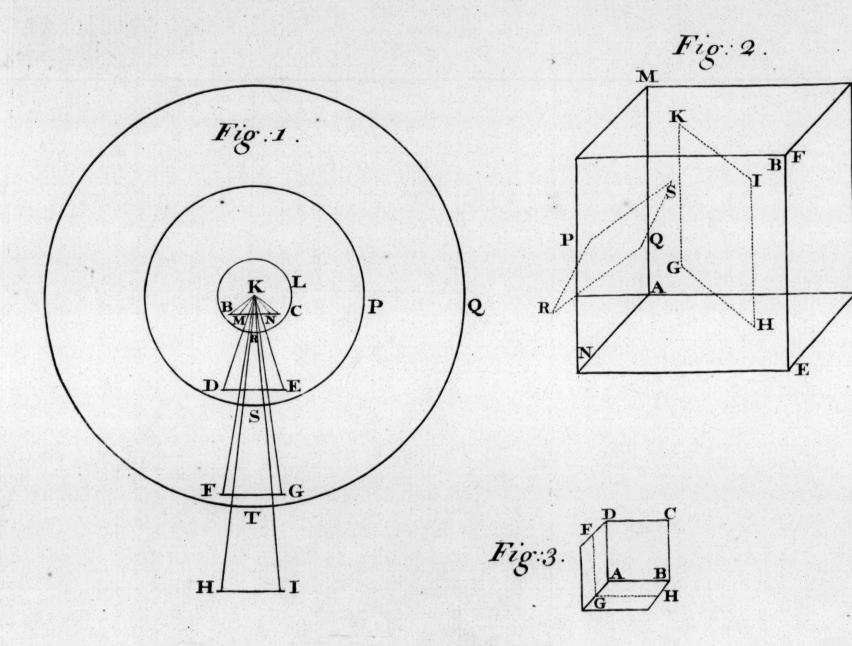
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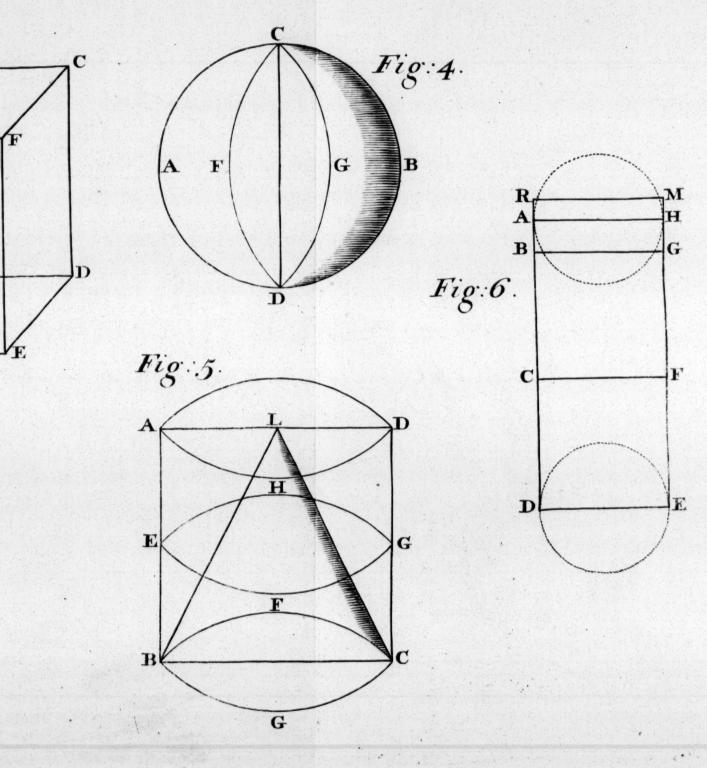
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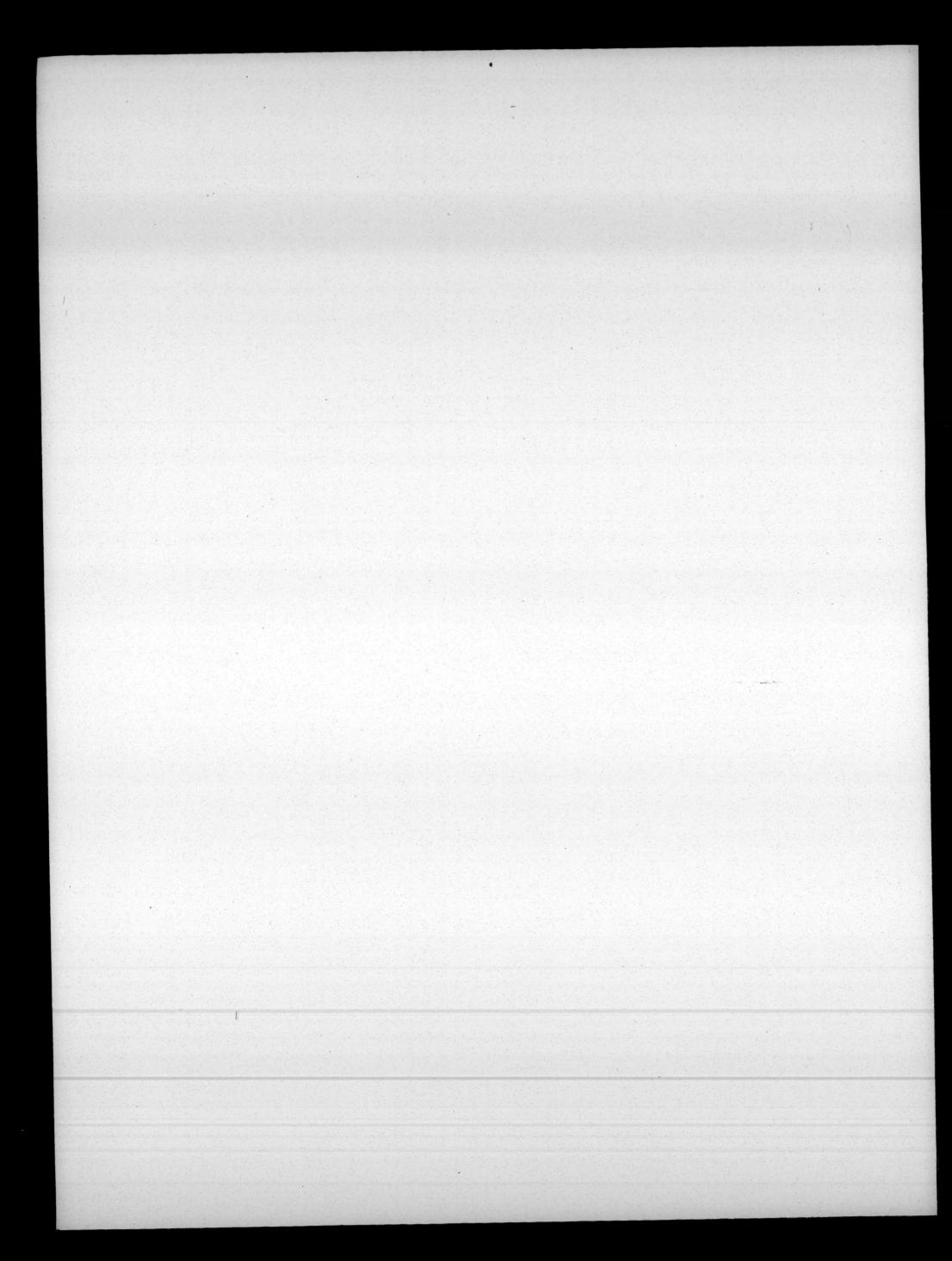
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Mathematical Elemental Lecture,

NATURE

OF

Elementary MATTER, and KINDS,

Confidered, and proved to be mixed;

Some Universal Properties

MATTER,
Demonstrated MATHEMATICALLY,

In a new MANNER: And

A great use of these Properties shewn,

INTHE

SOLUTION

Statical Phænomena of Fluids.

LECTURE I.

Nemo hujusce (LECTURÆ) utilitatem, nemo veritatem ejussine Matheseos ope comprehendet; cuilibet tamen in his vel mediocriter versato quæ sequuntur, non dissicilia erunt aut obscura.

C Keil. Tent. med. Præf.

LECTURE I.

HESE Lectures being designed as an attempt to explain some phænomena of nature, which have hitherto been the occasion of more admiration than knowledge, it may first be proper to treat succinctly of natural philosophy. Because the laws of matter being well established, there is hereby a clear passage opened into many intricacies of Nature, some of which, although long deemed above human ability, have been demonstrated to result from the known affections of matter.

As method has been always necessary in order to become intelligible, without which truth itself is not unlike falshood: The vulgar distinction of matter into four elements, shall be observed in the following Lectures. I say the vulgar distinction; not meaning hereby to establish them as really distinct original principles, prior to which there are none in the course of nature; this inquiry being too nice for the present: But seeing that the course of things is discovered, by proceeding from things most obvious to sense, to those areana of nature which are least so, it may be prudent to begin with the vulgar distinction of matter into four elements.

For the great and judicious Lord Verulam, having divided the hiflory of nature into five classes, makes the four elements the fourth
class, Fire, Air, Earth, and Water; taking the elements not
for primordial matter, but larger masses of natural bodies. For the
nature of things is so laid out, as to form a very large quantity or
mass, of certain bodies in the universe; where an easy and loose
texture of matter is required to their structure, as these four elements; whilst there is but a proportionably small quantity of certain
other bodies in the universe; thus sparingly supplied, by reason of a
very dissimilar and subtle texture of the matter, here made organical
and determined in many particulars, as in the species of natural Bodies, Minerals, Plants, and Animals: whence the former may be called, larger assemblages, and the latter, lesser assemblages of matter:

But the order of Nature feems to point out to us, the confideration of the larger assemblages as previous in order of knowledge, to the lesser assemblages (a). Our method shall in some degree, be consonant to this judicious remark, as well as the example of Sir Isaac Newton, who intending to explain the phænomena of the Universe; first lays down in a demonstrative way, what he justly calls, Philosophiæ naturalis principia mathematica: It is to be wished, that all reasoners upon particular phænomena would observe the same method, and first lay down the principles upon which they ground solutions of the difficulties of Nature; giving next in order, the descriptions and history of the phænomena to be solved, and after that the application of the principles to them, that is, the explanation of their physical causes.

The Inquirer, in imitation of so excellent an example, gives first the properties of elemental matter, so far as he thinks himself at present concerned in their consideration, partly mathematical, partly popular. The former manner of considering matter should have been omitted, was it not entirely necessary to his ground work, not being so treated of by Sir Isaac Newton, or any other person to his knowledge: After demonstrating the properties of elemental matter, the descriptions and history of the phænomena to be treated are given, and then follows the application of the principles first demonstrated, to the phænomena under

inquiry, that is, the explanation of the feveral physical causes.

The Inquirer means that the two first Lectures should be considered as the principles of his reasoning, in any other phænomena which he may hereaster attempt to explain, particularly the giant's causway, in the northern parts of this kingdom; as well as the phænomena which make the title of this book. For that very extraordinary phænomenon was intended to be made part of this book; yet for prudent reasons upon mature consideration was omitted. To proceed therefore according to this method.

But as a caution previous to all the demonstrations following, hear the

ingenious Keil.

'I would not have any one in physical matters, insist so much on a rigid method of demonstration, as to expect the principles of demonstration, that is, axioms, so clear and evident in themselves, as those that

⁽a) Introduction to Sylva Sylvarum. Apho. 4.

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• that are delivered in the elements of geometry. For the nature of the thing will not admit of such. But we think it sufficient, if we · deliver such as we apprehend are congruous to reason and expe-' rience, whose truth shines out as it were, at first view, which procure • the belief of fuch as are not obstinate, and to which no body can de-'ny his assent, unless he professes himself to be altogether a sceptic. But also in demonstrating, it is necessary to make use of a more · lax fort of reasoning, and to exhibit propositions that are not absolute-' ly true, but nearly approaching to the truth. As for example, when ' it is demonstrated that all the vibrations of the same pendulum, made, · in the small arches of a circle, are of equal duration; it is here sup-· posed, that the small arch of a circle and its chord, are of the same declivity, and of the same length; which however, if we regard the · rigid truth, is not to be admitted: But in physics, this hypothesis va-· ries so little from the truth, that the difference ought justly to be ne-· glected, and the disagreement of the vibrations arising from that difference is altogether infensible, as is proved by experience. So likewife that eminent philosopher and geometer Dr. Gregory, in his ele-· ments of catoptrics and dioptries, makes use of a more lax geometry, by affuming lines and angles as equal, that in reality are unequal, tho' · they accede nearly to an equality; and fo he folves many beautiful · physical problems, which otherwise would prove very intricate. · And also this method seems to be approved of sometimes by Sir Isaac · Newton himself, as may be seen in Prop. 3. lib. 2. of his Phil. Nat. ' prin. math. But if there are any who harden their minds against ' fuch principles and demonstrations, and will not suffer themselves to be convinced by propositions sufficiently manifest; we leave such to enjoy their supine ignorance, nor do we think them worthy to be ad-• mitted to the knowledge of the true philosophy (b).' With this allowance for a latitude in reasoning upon natural phænomena, what follows may be admitted for phylical demonstration.

Every man has a distinct idea of air, fire, water, and earth, although the philosopher by chymical processes may torture them, and himself,

⁽b) Introduction to Nat. Phil. Lectur. 8. See also Analogy of Divine Wisdom, &c. part I. published by the Author, in Dublin, 1750.

Mathematical LECTURE I.

fo as to render it doubtful whether there be in nature such an original distinction of elementary matter inconvertible one into another. Not-withstanding that we have very distinct ideas excited by the common use of these words, yet are those ideas very inadequate. Water is very distinguishable from air, earth, and fire, in the mind of every person; but an adequate idea of it, as being truly a mixt body, consisting of the pure original element of water, together with air, earth, and fire, in certain proportions, is not as often in the minds of those who are philosophically employed, as strict reasoning requires.

Yet such is the nature of all water on this our globe; whether rain, fountains, rivers, or the sea. And such is the nature of the other elements, they are all mixt bodies, greatly impregnated with each other;

which shall be demonstrated in propositions.

PROPOSITION 1.

Water has Earth, and Fire, and Air in it.

DEMONSTRATION.

Water has earth in it, otherwise it would not afford a terrene sediment, when allowed to settle and subside, nor throw it off superficially in fermentation. It has fire in it, otherwise in a storm the waves would not emit slame, and a small proportion of it thrown upon sewel in high combustion, would not perhaps increase the fire, as by experiment it is known to do; and the air which rushes out of vessels, in which water has been long confined, would not slame when toucht with a lighted candle. It has air in it, otherwise the fish could not live in that element, nor plants grow. For it is necessary to the life of all animals, and the vegetation of all plants.

Air has Water, and Earth, and Fire in it.

DEMONSTRATION.

Air has water in it, otherwise the vegetation of plants could not be carried on, many of whom receive their nourishment by the stalk, or leaf, and are very succulent, although they are situated in the driest exposure of walls and rocks (c): And if it has water in it, it has also by proposition 1. earth and sire.

It may also be proved abundantly that it has fire in it, by its being necessary to the support of fire, which also is ever known to increase with the admission of the fresh air, provided the quantity be not so great as to dissipate the sewel.

PROPOSITION 3.

Earth has Water, Fire, and Air in it.

DEMONSTRATION.

The drieft earth applied to fire will emit a vapour. But all vapour is water blown up into little bladders by air, and floating in it? Therefore earth has in it water and air. Consequently by prop. 1 and 2.

(c) See the description of the arbutus growing on high rocks, without any appearance of earth, in the account of the lake near Killarny.

Mr. Hughes his account of one kind of the Anana is to this purpose, See Nat. Hist. of Barbados. Caraguata, or the large wild barren pine. This in propriety of language, ought to be looked upon as an aquatic plant, though suspended in the air, among the branches of losty trees, to whose boughs it is fastened by its numerous roots, which serve not to suck, or draw from them any nutritious juices to further its growth, as the Misletoe doth from the Orange tree &c. but only to be its supporter: Provident nature having in a very extraordinary manner, supplied this with other means to preserve its species: For the leaves which resemble those of pine, but only larger, surround this plant in a circular manner, each leaf near the stalk terminating in a hollow bucket, which contains about half a pint of water. It is by these numerous small reservoirs of water, that the roots, as well as every other part of this plant, are supplied with nourishment, without the help of any earth. The slourishing condition of this, as well as the great growth of fig trees upon barren rocks, shews, that water is of greater use to vegetation than earth.

This author does not fay, whether the water in the buckets of this plant is owing to rain, or to the attractive power of the plant collecting it from common air. House Leek is a remarkable succulent plant, by the last method. See what Botanists say of the leaves of Aloes.

it has fire. But it may also be proved abundantly to have fire: Because almost all hard earth will upon collision with other hard bodies emit fire. It may also be proved abundantly to have air, because many hard and dense bodies applied to fire, burst with an explosion: And if hard and dense bodies contain air, a fortiori the more soft and porous do.

PROPOSITION 4.

Fire has Air, Water, and Earth in it.

DEMONSTRATION.

The great fountain of fire in this part of the universe, is the fun: but the fun is very well known by observers to be stained, and spotted by a fourf, which is thrown up over part of its furface; as in the cafe of all bodies liquified and agitated in an intense degree of heat. This condensed scurf incrusting part of the surface may be called earth; at least it is something very distinct from pure elemental fire; and since it cannot be called water or air, which are dissipable with heat, and in this case, one must be rarified to an immense degree of expansion, and the other blown into vapours of immense tenuity, neither of which could become durable stains, it must be called earth. Unless a fifth denomination of elementary matter be introduced (d): But if the fountain of our fire be thus mixt, all derivations from it, in rays falling upon a globe of heterogene matter, and blended with it, must become more

But it is not the design of these lectures to enter into a disquisition of so nice a point; which it may be extremely difficult if not impossible to settle; it suffices for the prefent purpose to demonstrate that there are four different sorts of matter in the universe.

⁽d) It is well known that it was the opinion of the ancient chemists, that fire, air, water, and earth, concur to the formation of bodies, but besides these, they supposed farther, that there is another fifth principle, which being added to the compound arising from the combination of the former, gives every body that peculiar disposition, on which • principally depends the colour, finell, tafte and virtue, of such a particular body. This 4 therefore being superadded to the other four essences, they called the (quinta essentia) quintessence of bodies. This they imagined to be contained in its body in an exceeding finall quantity, but at the same time to be vastly efficacious; and where it is separated from it, to be fit to animate the spirits of some other body, into which it is infused. (Boerhave El. of Chem. part 3. process 67.)

mixt; and consequently as it consorts with air, water, and earth, it must become airy, watry and earthy, as by Prop. 1, 2 and 3, Fire was proved to be in air, water, and earth.

COROLLARY 1.

From hence it follows, that all elementary bodies of this our globe. contain fomething of the other elements in them, and they are distinguished by the different names of elements only upon account of the greater abundance of a particular elemental matter in one than another. Water is called fo, because it contains a much greater quantity of true elemental water than of air, earth and fire, which it also contains in some proportion. Mix earth with water so as to give it that consistence, which is called clamminess, and it loses its former denomination and takes that of slime; drie that clammy earth by means of the fun or a culinary fire, and increase the fire till the earth is capable of continuing to burn by itself, then it loses its former name, and is called fire; for the name is always attributed to the greater abundance of any elemental matter. Air may be so impregnated with water, as to be called water; and water may be so divided and expanded by air, as to be called air. Earth may be so diluted with water, as to be called water: And water may be so thickened with earth, as to be called earth: Fire may be so intangled with other matter, as to take the names of other matter, as phosphorus &c. And that it is capable of being fixt, that is, in the vulgar fense of things (For in truth all matter is in absolute, and not

That these four sorts of matter are never found by human experiments totally separated from each other, but in some degree mixt; and that each of them in these mixt states, have certain peculiar qualities, and that an infinite variety of phænomena may arise from an infinite number of mixtures †, which these sorts of matter are susceptive of, from their capacity to admit of division to infinite minuteness. Instead of a quinta essentia, we may allow the immediate ACTIVITY of the author of matter, and this will do as well, since human experiments can never reach that quinta essentia (if there be such a thing) to discover its properties.

† Those who have written de arte combinatoria reckon no sewer than one hundred seventy nine millions one thousand and sixty sorts of earth. See Evelyn his treatise on earth. Kirchers his mundus subterraneus.

merely relative motion) the impregnating mercury with the rays of the fun, so as thereby to increase the weight and make gold, is a proof; for which see the writings of *Homberg*, and Sir Kenelm Digby (e).

COROLLARY 2.

All bodies of this our earth are mixtures of these four elements, and all diversity of them arises from mixtures in divers proportions; and although the diversity may appear to be infinite, an infinite number of proportions in which the elements may be mixt, may fufficiently account for a variety of productions, although they are infinite. For if any two elements are to be mixt in all the variety of proportions possible, it may be conceived first, as 2 to 1. or 2, 3, 4, 5, 6, 7 to 1, and so on to infinity, or as with to 1. or o1.001.0001.0001. to 1, that is, by an infinite increase of one towards the other, or an infinite decrease of one towards the other. For it is well known to the geometrician, that the smallest portion of matter is capable of infinite division (which shall be next demonstrated) and thereby of holding infinite proportions to any other portion of matter, which is itself also capable of infinite division. But if this be the case between any two elements, the variety of all proportions possible between four, must become infinitely greater, and confequently the variety of bodies arising from these mixtures can not be limited or conceived by the human mind. By this is not meant a mechanical account of the order of things, which never can be given accurately. Because HE, who made matter, is the Being who still acts, and continues in every phænomenon the laws of motion. No more therefore is meant by this, than whereas that Being is pleased to create matter, and use its passive instrumentality in producing various phænomena; the four species of elementary matter may be so combined, according to the laws, which the author of matter has given them, as to exhibit an infinite variety of appearances.

PRO=

⁽e) I remember a rare experiment, that a nobleman of much fincerity and a fingular friend of mine, told me that he had seen, which was that by means of glasses made in a particular manner, and artificially placed, one by another, he had seen the sun beams gathered together, and precipitated down into a brownish or purplish red powder. There could be no fallacy in this operation when the glasses were placed and disposed for this intent, and it must be in the hot time of the year, else the effect would not follow; and of this magistery he would gather sometimes near two ounces in a day.

Kenelm Digby, of bodies. page. 63. Homberg has exceeded this.

PROPOSITION 5.

Matter is capable of division to infinity.

DEMONSTRATION.

Since the infinite divisibility of matter has been mentioned, as a necessary part of what preceded, and may be of great use in respect to what follows, it will be proper here to give a demonstration of it. In this, and all other demonstrations applied in these lectures as little of mathematics shall be used, as is possible: And this particular property of matter having been largely demonstrated by Keil, in his introduction to natural Philosophy, a short demonstration of it shall suffice in this place; there is no design oftentationsly to exhibit mathematical literature, but only in a brief, and perhaps a new manner, to demonstrate some propositions necessary to the main part of our reasoning.

Suppose BC, DE, FG, HI in fig. 1. to be strait lines parallel and equal to each other, and K a point which is the center of the circle BRCL, and of the exterior circles. It is plain that straight lines may be drawn from B and C to K, and also from D and E, F and G, H and I, and from all possible lines parallel and equal to BC, and drawn beyond HI; that is, from an infinite number of lines: But it is also plain, that the lines which are drawn from DE stall between those from B and C, and cut the line BC at M and N, and those which are drawn from F and G stall between M and N and cut the line in points which are still nearer, and so on to infinity; because an infinite number of lines may be drawn, all parallel and equal to the first BC; that is, the line BC is capable of being divided into an infinite number of points.

The lines in the figure are drawn wide afunder for distinction, but they may be conceived to be drawn extreamly close, and instead of straight lines, you may conceive BRC a small portion of a circle BRCL, and BKN an angle at the center, and DSE a small portion of a circle DSP, and FTG a small portion of a circle FTQ, and the demonstration will be the same as before, and the superficial angle BKC will hereby be demonstrated capable of infinite division. Then suppose solid globes or

D 2 fpheres

spheres (or solid bodies bounded by singular and angular surfaces) instead of these circles, and BRCK, DSEK &c. to denote solid portions or sectors of those spheres, or solid bodies bounded by similar angular surfaces; and BKC a solid angle at the center, or a solid cone; and the demonstration is still similar; because there may be lines drawn to the center from the angular points, and all the points of the surfaces, removed at pleasure to infinity and parallel, which will in like manner infinitely divide BKC the solid angle, or the solid cone &c. Matter there-

fore is capable of division to infinity. Q. E. D.

Since the infinite divisibility of matter has been demonstrated, it will also be proper to demonstrate the increase of the surfaces of all bodies, upon division; for upon the truth of this depends the solution of many phænomena, concerning bodies, which may be made to swim in fluids specifically lighter. Hence it is that not only water and earth floats in air, but also metals. As there may be frequent use made of this proposition in what follows, and a demonstration of it has not any where yet occurred, it will be proper here to give a full demonstration of it. For the proposition already demonstrated by mathematicians, will not intirely answer our purpose, to wit, by division of regular solids, matter and gravity decreases in a triplicate ratio of the diameters; but the surface decreases only in a duplicate ratio of the diameters. Our design is to demonstrate, that every irregular section of a regular body, and the sections of all bodies regular or irregular occasion a great increase of the quantity of surface.

And first of the increase of surface in the division of a cube or die;

to demonstrate which, the following lemma will be necessary.

LEMMA.

Let ABC fig. 2. be a die or cube bounded by fix equal surfaces. Cut it through in lines equally distant from any two sides in the same plain, so as to divide it into halves. It is evident that each half of the die has over and above the half of all the surfaces of the whole die, the additional surface, markt by the prickt line GHIK, which is equal to one surface of the whole die, or spart of the entire surface. Divide the half dice

dice as before equally, cutting them parallel to the smallest surfaces, and each half, that is, each tourth part of the whole die will have an additional furface RPQS, over and above the whole furface of the entire body of which it is an half, that is, the part of the furface of the whole die, which is equal to one small surface, or half a large furface of the half die: Divide the four parts as in fig. 3. by cutting them equally distant from the smallest surfaces, and each half thereof will have the additional furface markt FGH, over and above the half of the whole furface of that intire body, of which it is half, that is, the part of the furface of the whole die. Therefore each eighth part of the large die, will become a fmall die, having six surfaces all equal. By continuing to divide the small dice or cubes, the same proportions of the increase of furface will be continued infinitely; that is, the aditional furfaces confidered collectively, as parts of the furface of the large die, and belonging to all the bodies in the division are 1, 2, 3, 4, &c. infinitely. For every fection passing through the intire thickness of the die, and being parallel to one of the furfaces, occasions an addition of two furfaces, each equal to one of the fix furfaces of the large die, that is, the part of all the furface, and the two make ...

ter, in the column B.

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The die or cube has	B C 6 plains
divided 1 *	more than 4
2	i more than i
3	$\frac{1}{8}$ $\frac{1}{72}$ more than $\frac{1}{8}$

A die may be divided by continual sections, into other dice of different magnitudes. By 3 sections it may be divided into 8 smaller dice, which for distinction's sake, we will call dice of the first order, being the first that arise from division. By 6 sections it may be divided into 64 dice of the second order. By 21 sections it may be divided into 512 dice of the third order, and thus to be continued infinitely.

From hence the proportion of the increase of surfaces upon division,

may be estimated.

PROPOSITION 6.

All the surfaces of the 8 small dice, which arise from the first division, and are of the first order, make twice the intire surface of the great die.

DEMONSTATION.

Each small die of the sirst order, has 4th the intire surface of the great die. For by the proportions laid down above, it appears that one of its surfaces is 24th part of the intire surface of the great die, but 34th part taken six times makes 4th, or twice the intire surface of the large die. Q. E. D.

Although there might be several propositions in the manner of the foregoing one, in consequence of the lemma, concerning the increase of surface by the division of regular cubes, yet it was deemed more elegant and succinct to give the following problem and its solution, in lieu of them all.

PROBLEM.

PROBLEM.

To find the proportion of surface upon the division of a cube or die, in the several orders, as above noted in the lemma, first, second, third, &c.

SOLUTION.

Now by multiplying the number of dice in each division, by the surface of each single die in that correspondent division, you will get the sum of the surfaces of all the dice, in the several respective divisions, thus,

1×1= furface of the large die

8×4=2= furfaces of all the dice of 1st order.

64×4=4= furfaces of all the dice of 2d order.

512×54=8= furfaces of all the dice of 3d order.

So that upon this kind of division of any one regular body, into other fimilar bodies of the same kind successively, the whole surfaces or sum of them will bear this proportion to each other — 1:2:4:8:16 &c.

The proportion of furface in all kinds of fections parallel, may be estimated in the following manner.

If the whole furface of the large cube be	=1=1
Upon a division into two pieces, the increase of surface	$=\frac{2}{6}=\frac{1}{3}$
Upon a division into four pieces, the increase of surface	$= \frac{4}{12} = \frac{1}{3}$
Upon a division into eight pieces, or eight similar cubes	$=_{2}\frac{8}{4}=\frac{1}{3}$
Now $1+\frac{2}{3}+\frac{4}{3}+\frac{8}{3}=2$	

Let us now consider the increase of surface, in the section of a sphere. ABCD Fig. 4. is a sphere; and a plain passes through it, in the diameter CD which divides it into two hemispheres.

PRO-

14 Mathematical LECTURE I.

PROPOSITION 7.

The increase of surface in each hemisphere is 4th of the spherical surface, and in two hemispheres 4 of the spherical surface.

DEMONSTRATION.

The surface of every sphere is four times its largest circle, (e), therefore the large circle EFDG being taken twice, (for it belongs to each hemisphere) is \frac{2}{4}ths or \frac{1}{2} the surface of the sphere. Q. E. D.

COROLLARY.

The numbers expressing the increase of surface, by continual sections through the center are \(\frac{1}{2}\), \(\frac{2}{3}\), \(\frac{4}{2}\), \(\frac{5}{2}\), \(\frac{6}{2}\) therefore every two sections give an increase of surface, equal to the whole spherical surface, and after 2000 sections, the aggregate of all the surfaces is 1001 times the spherical surface.

We will next consider the increase of the quantity of surface in the section of a cylinder.

Fig. 5. ABCD is a cylinder, whose side AB is equal to the diameter of the base BC, that is, which is as high as broad; and it is cut by a plain parallel to the base EFGH.

PROPOSITION 8.

Every section of such cylinder increases the surface by 3d of the first intire surface.

DEMONSTRATION.

The surface EFGH is 4th part of the convex surface ABCD (f), and it is equal to the top, which is equal to the base, therefore the surface

⁽⁴⁾ Theore. Selec. ex Archimede. Prop. 24. (f) Corol. to 12. The. ex Archimede.

furface EFGH is part of the intire surface of the cylinder; but EFGH belonging to each half cylinder must be taken twice, which will be the orthogonal of the whole surface. Therefore the increase is to of the first intire surface.

COROLLARY 1.

If the sections be continued, the increase of surface may be exprest by the following numbers, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{3}{3}$, $\frac{4}{3}$, $\frac{5}{3}$, $\frac{6}{3}$, $\frac{7}{3}$, &c. infinitely. Therefore by three sections the intire surface is doubled, by three more it is tripled &c. that is, every three sections is an addition of surface, equal to the first intire surface, and after 3000 sections, the aggregate of all the surfaces will be 1001 times the first intire surface.

COROLLARY 2.

In every cylinder of other dimensions, every section of this kind occasions an addition of surface equal to the sum of the surfaces of the top and the base of the cylinder, which, if in some cases it be less than the curve surface, in others may be much more.

Whatever the dimensions of the cylinder are, the increase of surface, may be estimated as above in the cylinder of equal height and breadth. For if an high cylinder may be divided into many cylinders of equal height and breadth, in that case, the proportions of all the surfaces arising from sections, bear the same proportion to the intire surface before section, as the increase of surface after one section, to the intire surface of one before section. If the cylinder be lower than broad, it may be considered, as such a part of one which is as high as broad, that the proportion may be easily ascertained. If the height be 4th of the breadth, every section gives two surfaces, each of which is equal to the convex surface; in this case, the increase of surface is by continual section as 2, 4, 6, 8, 10, 12, &c. And sifty sections will give for the aggregate of all the surfaces 103 times the curve surface.

Fig. 6. Let RDEM, a cylinder, be cut unequally in A, B, C, parallel to the base, that DC may be equal to CB, and BA to the of CB or to DB and RA to to BA or to GB.

Every section in the cylinder RDEM, is equal to 1 the convex surface CDEF, or 1 of twice that, BDE, or bears the same proportion to ADEH as 1.77-&c, to 9, or to RDEM as 2 to 9.35 &c.

Thus it is easy to determine the increase of surface in cylinders, whose

diameters and heights are unequal.

PROPOSITION 9.

Now suppose the cylinder to be cut downward from the top to the base, through parallel diameters of each AD, BC. Fig. 5.

The increase of surface by every section of this kind will be some-

thing more than 2 ds of the convex surface.

DEMONSTRATION.

By this kind of fection two equal furfaces are made, ABCD, one belonging to each half of the cylinder: And the convex surface is equal to the rectangle AB into BFCG, i. e. (h) the height of the cylinder into the periphery of the bale, and the surface ABCD is equal to the rectangle AB into BC. i. e. the side of the cylinder into the diameter of the base. But BC the diameter is something less than id (i) of BFCG the periphery; it is pretty nearly as 7 to 22. consequently the rectangle or plain surface ABCD is something less than i of the convex surface ABGCDH; and the plain surface taken twice (For it belongs to the two parts of the cylinder) is less than 3ds. If the numbers expressing the increase of surface be $\frac{2}{5}$, $\frac{4}{3}$, $\frac{6}{3}$, $\frac{8}{3}$, $\frac{10}{3}$, &c. there is an omission of a difference nearly of 2ths, which upon four divisions will make something more than a whole convex furface, and upon three divisions something less. And it is hitherto impossible to express the proportion accurately, because the proportion between the periphery of a circle and the diameter, which is the foundation of this proportion, can not be accurately fixt by the greatest geometricians. Yet as much, as we intend, is hereby fairly demonstrated, to wit, a great increase of surface: For four sections give more than twice the curve furface as an increase.

The section of the cone remains to be considered. Suppose fig. 5. LBC an upright cone upon the same base, and of the same height of the cylinder,

⁽b) Theor. ex Archimede. Prop. 11.

⁽i) Theor. ex Archimede. Prop. 6.

cylinder, and cut from the vertex L perpendicular to the base, so as to make two triangular surfaces LBC, one belonging to each half of the cone.

PROPOSITION 10.

The increase of surface by such sections as these, is exactly the same in respect to the convex conical surface, as in the former section of the cylinder, the quantity of surface generated being half the convex conical surface.

DEMONSTRATION.

The triangular furface LBC is half the rectangular furface ABCD. And the conical furface is half the cylindrical convex furface: But the proportion of half to half, is the same with that of the whole to the whole.—Therefore the increase of the surface is the same in proportion as in the former section, and the quantity of surface generated by the section of the cone, is half the quantity of the surface generated by the section of the cylinder.

GENERAL SCHOLIUM.

Thus may a great increase of surface be demonstrated in the sections of a cube, sphere, cylinder, and cone; and in as much as all masses of matter however irregular in their shapes, may be conceived to consist of exceeding small portions of matter of some or all these figures, at least approaching so near to them, as not to occasion any difference in the reasoning, (k) concerning them; the position therefore may be true of all matter; that upon division there arises a considerable increase of surface, that is, an infinite quantity of surface, the consequence of an infinite division.

The conclusion of the whole is, that matter as it decreases in quantity, increases in surface, and as it increases in quantity, it decreases in surface, and this differently in different figured bodies, but greatly in all; and in all regular bodies the decrease of gravity or matter upon division

⁽k) The whole globe may be considered as a perfect sphere, notwithstanding its vallies and mountanous parts, and the slatness at the poles; and some physical propositions may be demonstrated upon that supposition, whose truth is not invalidated by those small circumstances.

vision, is in a triplicate ratio of the diameters or sides, but the decrease of surface only in a duplicate ratio. For gravity is according to the quantity of matter or solid content; and that decreases in all regular bodies in a triplicate ratio of the diameters or sides, by Euclid, lib. 12. Sch. Prop. 18. and the decrease of surface in a duplicate ratio of the same

follows from Corollary to Prop. 20. lib. 6. Eucl.

But it should be observed, that when matter is demonstrated to be capable of division to infinity, and consequently of increasing the surface infinitely in proportion to the diminution of the quantity of matter; this does not hinder the acknowledging the existence of extreme hard portions. of matter, which by any action of matter upon matter, are incapable of being divided, or of having the form any way altered: For it is exceeding probable, that all matter confifts of fuch; and the probability of this arises in a great measure, from the very property already demonstrated. For the cohesion of matter is according to the number of points in contact, and therefore the strongest cohesion is between the smallest particles, because they having the largest proportional surfaces, are capable of touching in most points; consequently there must be in nature particles of matter to clotely adhering to others, that no finite force can separate them: But these are the smallest portions of matter; many of the larger masses being capable of an easy division: As in the common phænomena of flackt lime: When lime is first brought out of the kiln it is in the form of stone, which by means of water crumbles with a violent ebullition into a very fine powder; and whereas in the former state it was considerably weighty, being contained in a small space and incapable of being blown about by the wind, yet being reduced to powder, it increases in measure at least one third of the whole content, and is eafily born up into the air and dispersed by its motion. It is perhaps the great degree of smallness to which it is reduced, which renders it to excellent a cement with other matter, the frongest attraction being between the imallest particles.

The great uses of these properties of matter, and the necessity for them will appear in the following lectures; particularly in the frequent reference to them for accounting for the rising of bodies in fluids specifically lighter: such as gold and other metals in water and air. For these bodies being reduced to exceeding small parts, acquire a vast quantity of surface in respect to the small quantity of matter: And al-

though

though they are specifically heavier, they do not always make the fluids in which they swim, specifically heavier than the homogene fluid, to which it may be compared. For the honourable Mr. Boyle tells us, that

Mineral waters are sometimes lighter than common water (1).

Now without having recourse to suppositions, whether well or ill founded, such as a probability of original porous particles let us consider the nature and manner of fluids acting upon folids, so as to raise them, and a short remark upon that will clear this matter, which otherwise may seem to have difficulties. 'Fluids press upon bodies, to which they are contiguous, eve-' ry way, and on all fides, but the pressure upon each part is not the same; the altitude of the fluid is every where the measure of its force; and ' the several parts of the same body being at different depths, must needs be differently affected. We ought therefore to confider, which of all • these impressions will prevail. Now it is evident, that the lateral pres-· fures do all ballance each other, being equal, as arifing from equal al-' titudes of the fluid, and opposite in their directions; so that from these * the body is no way determined to any motion. But those parts of the fluid which are contiguous to the under furface have a greater altitude, and therefore a greater force, than the others, which are contiguous ' to the upper; therefore the body must of necessity be more violently ' elevated by the former, than depressed by the latter, and would therefore ascend by the excess of force, was it devoid of gravity. Now it is easy to understand, that this excess of force is equivalent to the " weight of so much of the fluid, as is equal in magnitude to the bulk of the body, being the difference in weight of two columns of the fluid, s whereof one reaches to the upper, the other to the under furface of the body.

Now suppose any mass of matter reduced to very small parts by division: These parts (in as much as matter is capable of infinite division) may be conceived so small (m), that their surface is exceeding great, in respect to the quantity of matter contained in them, that is, their absolute weight;

confequently

⁽¹⁾ Partly because they are impregnated with volatile parts, and partly because they are void of saline parts, which make common water something heavier.

Boyle abridged by Boulton, vol. I. p. 290.

(m) I have tried that half a grain of marchasite, dissolved in spirit of nitre, communicated a tincture to 61440 parts of water, tho' part of that marchasite was sulphur, and part of it caput mortuum. Boyle abridged by Boulton, Vol. I. p. 299.

consequently in a fluid the difference between the shorter column which presses them down, and the longer column which presses them up, is exceeding great in respect to their gravity, which becomes inconsiderable,

therefore the particles must rise in the fluid.

If it should be alledged in opposition to this demonstration, (For even mathematics is liable in some cases to the appearance of contradictory demonstrations) that the specific weight of any body, being as its density, when it is comminuted, every small portion will still be proportionably weighty; and therefore if a cubic inch of gold, is heavier than a cubic inch of water, so will the cubic inch of a third order of that cube of gold be heavier than a cube of the same order of water; and so on to infinity. To this may be answered; the solution of all phænomena in nature must at last end in miracle, and the Divine FIAT can alone account for the last appearance. However in this case something may be

faid without going beyond fecond causes.

The weight of bodies depends upon the quantity of matter, and the specific weight upon the quantity within equal surfaces. But the kinds of pores, (for all bodies have pores,) may be very different. Gold is specifically heavier than filver. But the whole void space or the aggregate of all its large pores, is not equal to the whole void space, which will arise from the aggregate of all the smaller pores of silver. We may therefore suppose such matter compounded in such a manner, as to an-Iwer the phænomena of rising in fluids, when reduced to small parts, which descends, when it is in gross masses; for the very small particles may be extreamly porous, and there may be within them again, smaller and more porous particles; till at last you come at original indiscerptible and perhaps imporous particles. When gold is divided into the first kind of smaller particles, it may swim in water, when into the fecond which are smaller, it may swim in air, when into a third which is still smaller, it may perhaps float in the vacuum of Boyle: And yet a mass of this matter may be specifically heavier than any known body. To illustrate this, imagine very small hollow cubes of gold, imagine wool, or any light substance, and each cube lighter than so much water thrust into them, these may be fitted together so as to make a mass of matter which shall outweigh an equal bulk of water.

If it should still be contended that this gravity of the small particles is something, and of moment, and should hinder the effect. It may be further answered, that the gravity is certainly something, yet of no mo-

ment in the phænomena; and therefore should not be rated upon account of the more considerable effect, owing to the increase of surface. For if these extreme minute forces are not thrown out of account, hardly any phænomenon can be explained; the second causes of things seeming so frequently to interfere with each other, that without the neglect of some, which have the least share in producing or retarding an effect, our reasoning upon things would be so embarassed that a very short progress could be made in natural things. And of this the hydrostatical rule of Archimedes, is a very remarkable instance and close to our purpose.

" For if we should be scrupulously exact we may easily correct a small " error in the rule, namely, that the part immersed in any fluid is to the

" whole, as the gravity of the folid to the gravity of the fluid.

"For fince the air is an heavy fluid, tho' it be perhaps the least heavy " of all others; yet by resting upon the body it has this effect, that in " reality it will not admit a folid to be altogether fo deeply immerfed, " as it would otherwise be, if the air were removed, which the rule " supposes: Allowing then for the air's presence, we may thus ex-" press the proportion: That the part immersed is to the whole, as the "difference in weight of the folid and an equal bulk of air, is to the " difference in weight of an equal bulk of the fluid, and the same equal

" bulk of air. Whosoever will compare these two rules together, will " find, that their difference is altogether inconsiderable: We may there-

" fore still make use of the old one without any further scruple."

Thus reasons the judicious COTES.

In like manner the gravity of exceeding small particles of gold is fomething, yet of so little moment as not to hinder the rising of very small particles of heavy bodies in light fluids, upon account of the greatness of the furface.

To all this may be added, one circumstance more of considerable importance to fluids, to inable them to support bodies specifically heavier, and that is, their clamminess and tenacity: A small needle of steel shall fwim upon the furface of water, so long as the upper part of the needle remains dry, the fluid being quiescent; and many other things will float in the fame manner: small particles of matter likewise specifically heavier than water may swim in oil, which itself is specifically lighter than water. Beverage prepared for the use of man, shall be extremely clear, and upon a little agitation of the vessel be so discoloured, as to require weeks and months to be clarified by a subsidence of the heterogene matter; tho' that matter be specifically heavier, and in many cases by that

principle at last subsides; yet the tenacity of the fluid shall detain it a long time, perhaps for some years; as may appear from instances mentioned in other parts of these Lectures. And further add to all this MOTION, and the ability of sluids to support specifically heavier bodies is still increased, as well as the ability to immerge light bodies: By this it is, that dust in windy weather is raised in the air, that mud floats in rivers and lakes, and hereby many phænomena of extraordinary

consequence are occasioned.

In this lecture have been considered and demonstrated, two universal properties of matter, and the distinction of matter into sour elements, and the composition of each. In the following lecture, the properties of each element shall be more particularly considered and demonstrated, and the phænomena which shall make the foundation of reasoning, shall be rather those of the common than the rare kind: For although rarity strikes the mind more, yet it informs it less. When this shall be done, as is hoped, with a good degree of satisfaction; some phænomerna of the rare kind shall be laid before you, and the laws of matter

previously demonstrated shall be applied to them.

Having thus finished the mathematical part of our design, which tho' not of the marrow, but rather the surface of that science, is sitter for a reader than a hearer; as indeed every thing in that science is; a favour must be requested of all those, who peruse these matters with attention, not to reject the truth or censure the whole, if any error in the numbers &c. may have slipt from the pen. Great men have erred, and the main tendency of their writings has not been destroyed thereby. The ingenious Borelli thought he had demonstrated, the force of the heart to protrude the blood, to be equal to 180000lb. Yet the accurate James Keil has since demonstrated that the force of 1lb. will protrude 10clb. of blood. A Borello quidem ponderi 180000 librarum æqualis incorde vis, quæ viginti libras sanguinis moveret, desiderabatur: Sed ex supra

demonstratis patet, centum libras sanguinis, à vi cordis non unam libram excedente, moveri posse. Hoc nonnullis aut procul intuentibus, aut

parum cogitantibus mirum fortasse videri potest; quod si hanc rem propriùs et penitiùs inspiciamus, nihil huic vi cordis attributum in-

veniemus, quod non abunde potest præstare.' Keil Tent. med.

In the same manner, others have erred, and yet preserve an eminent fame: That therefore which the most ingenious can not avoid, is pardonable in all.

THE

Popular Elemental Lecture,

ORTHE

PROPERTIES

OF THE

Four ELEMENTS,

ENUMERATED and PROVED,

Principally from the most obvious

PHENOMENA.

LECTURE II.

Nature has an universal principle for each class of things, and therefore the contemplation of all natural things conduces to the knowledge of a particular one; so, from a scientifical knowledge of any one, does follow the same of all and every one. See Hook his defcription of experiments on Lignum Fossile, page 106.

No man can advantageously discover the nature of any thing, in that thing itself, but the INQUIRY must be extended to matters that are more common.

Lord Verulam his new Machine. Aph. 70.

LECTURE II.

N the former lecture, the four elements having been considered as mixt bodies; in this, the properties of each shall be particularly laid down, upon the same consideration of their being mixt bodies. And the phænomena applied to this purpose, shall be for the most part such as are most commonly to be observed, meaning to treat the subject popularly; yet with strict regard to truth in the laws of Nature: And whereas our design is to hasten to the main purpose, to wit, the application of demonstrated properties of matter, to particular phænomena, the demonstrations shall be as short, but as clear as possible.

The element which feems to have the nearest relation to animal and

vegetable life, shall be first treated of.

AIR is an elastic fluid, incompassing this globe of earth, and pervading it, capable of a great degree of expansion and condensation, and of a great increase of elasticity and diminution of it. It is a principle of the preservation of life in all living animals and vegetables, and a principle of putrefaction and corruption in them, when they are dead. It abounds with all forts of matter, and holds perpetual commerce with this our globe, in receiving exhalations pregnant with particles of various kinds, and forming dew, rain, hail, frost and snow.

It will be proper to treat these in distinct propositions.

PROPOSITION 1.

Air is an elastic fluid capable of a great degree of expansion and condensation, and of a great increase of elasticity and diminution of it.

DEMONSTRATION.

Air fuddenly expanded by the means of gunpowder fired, is capableof giving a valt force to engine of war; and fire in the bowels of the earth shall so rarify it, that it shall produce earthquakes, burst the surface, and throw out immense quantities of matter with such rumbling founds, as terrify mankind. Animals fuddenly immerfed in water to great depths, by means of diving bells, shall be compressed to death by the condensation of the air furrounding them; and if they be gradually immeried to as to take in the denie air without destruction, and be suddenly railed to the thin atmosphere above the water, they shall burst by means of the dense air within expanding itself. The destruction, or even diminution of the elasticity of the air, is not observed in the sedentary air sometimes found in vaults, and large oyl jars, which have been many years empty of oyl, and lie in close places; nor in some kinds of damps in mines, although they are known to destroy life, and extinguish fire, as air passing through a tube from one fire to another will extinguish it, and air passing through the lungs of any animal, becomes unfit for respiration. In public assemblies where there is not allowed a free passage for the air, the air that is confined having been once breathed, will extinguish the candles, occasion fainting, and the hazard of life.

All those phænomena are not owing to the diminution of the elasticity of the air. For by experiment such air has been found equally elastic with wholsome air. There is therefore some other quality necessary to be found in air, in order to preserve life and sire, besides elasticity; but in this proposition, we are to consider only the increase and diminution of elasticity in that element. By condensing air, it is rendered more elastic, and by thinning, less so; yet the action of thinning, shall produce the same effect with that of condensation in some instances, and be of equal sorce. A ball may be discharged from a gun, by means of air condensed by an engin for that purpose, with equal sorce with a ball discharged by rarified air, arising from instance gunpowder. Yet when air is once expanded by heat, and any quantity of it possessing a certain space, is compared with that of condensed air, possessing an equal space, the former shall.

shall be less elastic than the latter, and that in proportion to the comparative degrees of density. They who climb to the tops of high mountains, find in breathing a sensible diminution of elasticity, density or weight of air (which are always proportional) and as they descend, a sensible increase.

Air seems to be capable of elasticity in proportion to resistance: In so much that a small quantity of it rarissed in a gun barrel, is not only capable of bursting it; but if the globe of earth incompassed it without any aperture, when it is in a state of rarissication, that is, of exerting its elasticity, it would burst that also; although it should immediately return to its former space, the cause ceasing to act which excited it to expansion; hence all the dreadful phænomena of earthquakes, well known in some parts of the world.

PROPOSITION 2.

Air incompasseth this globe of earth and pervades it.

DEMONSTRATION.

This property necessarily follows from the demonstration of the former. For the phænomena of gunpowder could not happen beyond the furface of the earth, without an external air, nor those of earthquakes without an internal air.

PROPOSITION 3.

Air is a principle of preservation of life in all living animals and vegetables, and a principle of putrefaction and corruption in them when they are dead.

DEMONSTRATION ...

In as much as the circulation of blood in animals, and the motion at least, if not the circulation of juice in the plants, is absolutely necessary to life in all. Air is also necessary to life and a principle of it; for it is a principle

a principle of those; that is, air in a sound state: For stagnant, or non elastic air has been shewn in the former demonstration to be destructive, of life. Elastic air entring the human body by inspiration, is expanded by the heat of the body, and thereby gives motion to the blood, and having done its office is expired, and fresh elastic air succeeding repeats the impression by its springy quality, and preserves that miracle of perpetual motion (n): Miracle, I say, because the blood moves even contrary to mechanic laws, and slows up the perpendicular height of the body: Whereas the nature of all sluids is to descend by the force of gravity. This, together with a vivisying spirit, the concomitant of wholesome air, preserves the animal life.

Mr. Boyle expresses his sentiments in the following manner. 'I think that the necessity of the air's presence to preserve and continue slame, is a sufficient argument of some latent spirit or quality, whether vital substance or nitrous spirit diffused through the air, on which likewise

the life of animals depends, and without which, they as well as flame,

· presently are extinguisht and die.

'The air feems to be a substance capable of being assimilated by every body, or it consists of all sorts of seminal corpuscles: So that any body may find a substance there, analogous to it, and fit to make up a part of

the same body (0).

Air is a principle of the vegetation of plants also, being in many respects necessary to their growth. It enters the roots along with the moisture of the earth, and being rarefied by the solar, or subterraneous heat, it promotes the motion of the sap upward, and carries off the superfluity of it in the form of vapour at the leaves. For air mixing with water, and rarefying it, whilst it is rarefied itself by heat, can increase the surface of little congeries of water, so as to form bubbles

Pitcairn and Porterfield's argument.

⁽n) The head, heart, arteries, veins, and nerves, should be formed at the same time, which can never be done by the motion of any fluid, what way soever moved: For the heart can not move, unless animal spirits be sent from the head through the nerves into it. The animal spirits can not be derived into the heart, unless the blood be squeezed by the heart, through the arteries into the brain; so that it is evident, the head and heart, the arteries, veins and nerves, must all be formed at the same instant, and not successively. But this is altogether impossible by the laws of mechanics: For no motion of any fluid, or fluids howsoever disposed, can form all these at the same time, and we know all the internal mechanical actions of animals, are performed by the force of their circulating sluids.

⁽e) Boyle abridged by Boulton, Vol. II. p. 304.

bles or vapours, which thereby rife as effectually, as if the absolute gra-

vity of water was leffened.

Air has also by its capacity of being condensed, whilst it is in the action of obtruding the sap, upward, and laterally, to the growth and increase of the plant, unites itself so closely with many parts of the plant, as to become the fixt substance of it; and holds no surther commerce with its own active element, being tied to sluggish parts of matter, till putrefaction or some chemical process disengages it, and sets it at liberty. For this air, which in the progress of the growth of animal and vegetable bodies, becomes constituent parts of them, will by means of heat separate itself in a state of death; occasion a motion, fermentation, and at last disruption of all the other parts, which is called putrefaction; and these parts shall thereby be carried off into the atmosphere, and render it offensive and unwholsome to living animals; hence it is that famines often produce plagues.

PROPOSITION 4.

Air is prædatory and corrodes all inanimate substances.

DEMONSTRATION.

The ragged appearance of ancient buildings, whether of marble or freestone, and the rust of the hardest metals sufficiently demonstrate this. Perhaps there may be one exception only of all forts of matter to this. Gold is not capable of being dissolved by any thing, except sea salt, or some menstruum prepared from it. Hence it comes to pass, that it never rusts; for there is no such thing as aqua regia, or spirit of sea salt in the air, as the chemists say. Yet gold may be in some circumstances so intangled with other matter, particularly with mercury, as to become volatile and flie up into the air. This is very furprizing that a mixture or union, of the two heaviest bodies in nature, should become capable of Suspension in the lightest stuid. But this is no more than a fair consequence, from what has been demonstrated already in the first lecture, of the great increase of surface by the division of matter: For the heaviest body may be reduced to fuch small parts, as to become more capable of suspension in a fluid than any other, not so minutely divided. PRO-

PROPOSITION 5.

Air abounds with all forts of matter.

DEMONSTRATION.

Since it is perpetually preying upon all the seeming fixt substances of the globe, by raising intestine motions in them, and carrying off confiderable spoils by putrefaction and corrosion, and having no store houses for the reception of all this matter, except the open atmosphere: that atmosphere must abound with the minute particles, of all forts of matter; and that in very different proportions in different places, according to divers strata of matter to be found in divers places of the furface of the globe; and according to different influences of the fun in several climates and seasons. Some countries and some seasons shall be remarkable for thunder and meteors, and dews; others for little of those, and abundance of rain. Some for frost and snow, some for long druth and fragrant smells in the air, owing to the spices and aromatic plants; and some particular places for poisonous air, owing to the effluvia of poisonous plants; some places also remarkable for sulphurous and mineral exhalations. Thus much may suffice for the properties of the air, To far as concerns our purpole.

The PROPERTIES of the element of WATER shall be in-

quired into next and demonstrated.

Water is a fluid element, and void of elasticity, almost incapable of being condensed or expanded in a gross state, yet capable of such a degree of expansion when reduced to vapour, as to float in air. It is very penetrating and infinuates itself into many bodies, so as to separate their parts, and in this respect is an extraordinary menstruum; yet it unites others and makes masses of loose matter become exceeding hard. It is without taste, without smell, without colour; by extreme cold, losing its fluidity, and becoming hard under a new denomination of ice.

PROPOSITION 6.

Water is a fluid element void of elasticity, almost incapable of being condensed or expanded in a gross state, yet capable of such a degree of expansion in vapours, as to become lighter than air, and to float in it.

DEMONSTRATION.

Rivers and fountains have their banks to confine this element, which otherwise would flow indifferently on all sides; and the sea must have its shores, otherwise the whole surface of the earth would be covered with water. When it is taken in small quantities for human uses, it must be confined in vessels of such a closeness, as to materials and workmanship, as not to allow it a passage, except where the artist intends. And when it is confined to a veffel without any aperture at all, suppose of metal (as the experiment has been tried with a brass globe) it is not capable by any force of compression, of being reduced to a narrower space, but will either burst the vessel if violently prest, or passing through the cracks (o) of it appear upon the surface like a dew. If it seems to have elafticity from some appearances, as that of stones and cannon balls rebounding from it, at a certain degree of inclination; those appearances may in some measure be attributed to the great quantity of air contained in common water, which a pure element of water would be free from: But this can have only a small effect. Therefore the expansion of water in a boiling state, which some have found to be sith part of its dimensions in a cool state, may be attributed to a violent motion, which occasions what are called fulminating bubbles, as well as to the expansion of the penetrating air.

This proportion of expansion (p) belongs to water, as pressed by the common weight of the atmosphere; but if we suppose water pressed with a

(p) Boerhave Chem.

⁽⁰⁾ Cracks is used here instead of pores, as being the true manner of expressing it. For water can not by any force be made to pass through pores, through which it would not pass by mere gravity or attraction. The spherical body can not be compress without altering its figure, and consequently not without occasioning fissures, through which the water may pass, although it could not pass through the pores. Perhaps there may be a small degree of compression (tho' not capable of being brought under computation) owing to the air contained in it. Perhaps also in some instances to other physical causes. See the generation of ice, page 36.

more weighty atmosphere, or with any other fluids, such as boyling oylor metals melted, its expansion when tried in smaller quantities, is such, as to produce very terrible effects, and scatter the boiling mass with a great explosion. Its capacity of rising in vapours, is owing to its capacity of expansion in small masses, and the expansion of the air which it always contains, or readily admits by Prop. 1. Lect. 1. This air rarised by heat, reduces the heavy water to vapours, of the form of little blown bladders, lighter than so much cool air, and capable of floating in it, which therefore briskly ascend into the atmosphere, and that often with such force as to be the means in fire engines, of raising water out of mines and subterraneous places, at the depth of some hundred feet; whereas by means of the intire pressure of the atmosphere, water in common pumps can only be raised two or three and thirty feet.

SCHOLIUM.

The case of bodies rebounding from water, having impinged obliquely

upon its furface shall be considered.

Water is not elastic, for not being capable of condensation it can not be contracted into more narrow bounds, and afterwards expanded to occupy its original space; which is the manner whereby wool, air, and many other elastic bodies restore motion: Yet water has a property whereby it produces fimilar effects with elafticity: A cannon ball rebounds from the surface of the sea, with a force sufficient to do great mischief: A flat stone thrown obliquely on the water shall rise and fall, and rise again, with leveral alternations, before it loles motion: The cause of this is, the water's quality of yielding to force, and the neighbouring part of the fluid riling thereby in circular waves, which by gravity immediately endeavouring to subside, must suddenly swell or raise the hollowed furface, and thereby give a new direction to the moving body, which had struck the fluid surface in an oblique direction; which body rifes with a diminution of force, and so on, untill the imprest force being exhausted, nothing acts but gravity, and the body sinks, if it be specifically heavier than water. The diminution of force in these cases, is owing principally to the resistance of the air, the motion being horizontal; and partly to the non-elasticity of the water, to whose lurtace

furface the direction of motion being oblique, only part is diminished thereby: But if the direction of motion was perpendicular to the surface of the water, and the body sell upon a sluid surface exactly equal to itself, in a vessel confining the water to the shape of the falling body, in that case upon collision there would be a total loss of motion, and consequently no repercussion: For the closeness of the vessel to the shape of the falling body, would hinder any waves to arise laterally: and the water not being elastic can not convene closer, and spring again, to its former dimensions; as was demonstrated before.

But although water has not that kind of elasticity, which wool and other similar kinds of bodies have, which may be comprest into a narrower space; yet it should be considered, whether the property of water, where the upper surface is only bounded by the air, does not nearly resemble the motion of a spring of steel, which acts elastically, not by being comprest into a narrower space, but by being bent; so as to occupy another space neither more nor less than the former, and immediate

ately restoring itself to the possession of the original space.

Water by a manner fomething fimilar to the motion of a spring of steel changes the direction of motion, but instead of restoring motion, diminishes it; and is a non-elastic body, (p) except in as much as it always contains more or less air, it must partake more or less of elasticity: Hence perhaps in a fummer shower of rain, which sometimes falls fuddenly, and in very large drops, one may observe upon the surface of a pool of water, fomething that looks like a rebounding of each drop from the surface: But it should be remarked, the form of that rebounding matter, is not orbicular as drops of rain are, but like a short column of water erected upon the surface, and continuous to it. The same columns appear, but sometimes with an orbicular top; when water falls in drops upon the same fluid, contained in a basin for the experiment; but by increasing the height of the fall, you will not in proportion increase the height of the ascending column or drop, which should be the case, if water was elastic. For an elastic tennis ball, will rebound perpendicular, in proportion to the force with which it strikes the elastic G 2 floor;

⁽p) Gravitas undarum supplet locum vis elasticæ. Newtoni Philos. Nat. Prin. Math. Prop. XLIII, lib. II.

floor; that is, in proportion to the height from which it falls, if the

force of gravity alone be the impeller.

In the falling of water in the form of drops, it is not so; for the drops of rain falling in the warmest summer's day, when the vapours may be supposed to ascend highest, and being in great abundance, upon collection form larger drops than at any other time: The columns of water after the percussion of each drop, is not seemingly so high as that of an ordinary drop of water, let fall for the sake of experiment, from the height of three or four feet. From which height you may observe a column about one inch and an half, growing taper towards the end, to which there seems joined a little sphere of water, which quickly returning by the force of gravity, excites a low sound, after that of the first drop, as if a small one fell immediately after a large one.

If water drops from an height upon a board or marble, it will split into small portions and slie obliquely; but this is only a change of direction of motion, and a division of the moving body; and something of the same effect there will be, when water falls upon water in form of drops: But otherwise when it falls in a gross body, as appears from cataracts, near which a spectator may conveniently stand without annoyance, except that of a fort of dew, which the violent collision of the water rather against rocks or the hard matter, that contains it, occasions,

than any action of itself upon itself.

PROPOSITION 7.

Water is very penetrating, and infinuates itself into many bodies, so as to separate their parts, and in this respect is an extraordinary menstruum, it also unites and makes masses of loose matter become hard.

DEMONSTRATION.

The phænomena of dissolved sugar, salt and gum, by water, are well known, as well as the uniting of slower to make paste, and lime and sand to make mortar by water. Dry earth or clay, may first be dissolved by water, and then being dried again, shall become a harder body than it was before.

PROPOSITION 8.

The element of the water, is without taste, without smell, without colour.

DEMONSTRATION.

All colour in water is univerfally attributed to some heterogene matter mixt with it: And the practice of water drinkers (q) does sufficiently inform us, that true water is only that which is without taste and smell; for such they always prefer for Beverage, when it can be had.

PROPOSITION. 9.

All water has a petrifying quality.

See this demonstrated in Lecture 5. which is placed there, because having a closer relation to the principal phænomena under consideration, it should stand in the nearest point of view.

PROPOSITION. 10.

Water is capable of losing its fluidity, becoming hard under a new denomination of ice.

DEMONSTRATION.

In these northern countries it is needless to demonstrate this, any other way, than by referring to the phænomena of every winter; although in hot climates between the tropics, the asserting of it would remove all opinion, of the veracity of the person asserting it. Instead of a formal

(q) Sentiri quidem aquæ saporem ullum vitium est—odor nullus est in aquis; aut si sentitur omnino vitium est. Mirum tria Naturæ præcipua elementa sinc sapore esse, since odore; Aquas, aera, ignes. Plin. Nat. Hist. lib. 15.c. 27.

formal demonstration of it, some properties of ice and the manner of its

production shall be laid before you.

There will appear a good reason for this hereaster, when the generation of the crystals of the lake come to be spoken of, the ancient opinion having been, that they are ice brought to such a degree of hardness, as to become incapable of dissolution by warmth.

Ice is lighter than water, and therefore swims in it.

One certain degree of cold always produces it, and a greater degree of cold, produces harder ice. Yet the same degree of warmth, always dissolves the hardest as well as the softest.

It has been observed that ice often begins to thaw in the lower surface, which therefore is owing to the influence of central heat conveyed

through the pores of the earth.

Ice is elastic although water is not so, and the harder the ice, the more elastic, as is plain from hard bodies rebounding from it after percussion; it is in all things like glass, except that of not bearing fire in a certain degree, and yet it contains fire in it, in some degree.

The manner of the production of ice may be explained thus. All water has air in it, Prop. 1. Lec. 1. And this air being dispersed through the fluid, in very small separate portions has very little elasticity; but when the particles of the water, are by cold constringed and pressed closer together, the small cells of air are also pressed out of their places, and blended with one another, to as to form much larger cells of greater elasticity: Hence it is that although the pressing of the matter of the element of water, to as to make the matter of it, wherever it is, denfer, and therefore heavier, yet upon account of the large cells of air, which perhaps have also received an increase from the ambient air, at the beginning of freezing, a quantity of water when turned to ice, is made to occupy a larger space, and is therefore specifically lighter. This manner of production explains the reason also why ice burits vessels, and why ice which is made in vacuo, the water being previously purged of air, is to heavy as to fink in water, not being equally expanded for want of an equal quantity of interstitial air; but all ice made in the open air Iwims in water being in specific gravity to water as 8 to 9. But in as much as air can not be totally exhausted by any pneumatic engine, out of any space; ice may be formed in vacuo according to the philosophy just laid down, yet that ice shall differ in weight specifically, from ice formed in the open air.

It is very remarkable, that there is no intermediate degrees between water in its fluid state and ice; that is, water is always equally sluid, and when it ceases to be so (which one certain degree of cold occasion) it becomes ice: Boiling water is not more fluid than the coldest water, immediately before it becomes ice.

The properties of earth shall be next inquired into and demonstrated. Earth is that matter upon which we tread, but in as much as it is hardly possible to take two steps upon exactly the same kind of earth (r); it must not be defined by any qualities peculiar to any portion of earth, but by those which are common to all portions of it.

Earth is hard, refisting touch and fire; it is brittle and does not diffolve in water, but subsides in it, or contains it as a basin.

PROPOSITION. 11.

Earth is hard, refifting touch and fire.

DEMONSTRATION.

The idea of foft we are fensible of, when we feel water; for its parts easily yield to a pressure, and slip away from the pressing body; but earth yields with more difficulty, and if the pressure be forcible, occasions pain or damage: And whereas water goes off in vapours excited by the force of fire; earth keeps its station, and although it may seem to suffer a change upon account of other elements mixt with it, yet the elemental earth suffers none. For earth burnt to a brick, is still earth with a diminution of water which it once had united to it, and an addition of fire.

PROPOSITION 12.

Earth is brittle and does not dissolve in water, but subsides in it, or contains it as a basin.

This

This is generally true of visible common earth of the globe, and strictly true of the virgin earth, which chemists by fire separate from the other elements, of which they make their best vessels for containing matter, on which they try experiments in intense fires. But our purpose being rather to speak of the elements in the gross form, that is, in the mixt form in which they are constantly to be found, as the functions of nature are exercising in the globe; in that sense we say also that earth is brittle, and does not dislove in water, but subsides in it, or contains it as a basin.

The brittleness or friability of earth, appears to any one who uses the hand or hammer, and although after it is crumbled and thrown into water, some kinds of it may seem to dissolve and swim in the sluid, it afterwards subsides; except that part of earth which makes part of the gross element of water. For by the propositions in the former lecture, every element contains in it some parts of all the other elements.

That earth makes convenient basins for water, appears from the view of fountains, lakes, rivers and the sea; all which are supported and bounded by earth; which boundaries were they necessarily liable to dissolution by water upon contact, would mix with it, and that which we now call a globe of earth, would become a globe of clammy fluid.

The properties of fire shall be enquired next into and demonstrated. Fire is the most subtile of all the elements, it penetrates all bodies, separating the parts of some, and uniting the parts of others; and actually takes place in every body, and exists also in places almost totally vacuous of other matter.

PROPOSITION 13.

Fire is the most subtle of all the elements and penetrates all bodies.

DEMONSTRATION.

If fire was not the most subtle of all elements, there might be found some bodies too compact to admit it; but none such can be found: The densest bodies admit it most plentifully and retain it longest, for the proportion of heat which bodies are capable of receiving is in proportion to their densities. Iron is capable of receiving a greater degree of heat

heat than wood, and marble is more susceptive of it than plaister: Of woods the weightier are susceptive of more heat than the lighter: Oak is susceptive of more than fir deal. But some allowance is to be made for the tenacity of the parts whereby in some instances, the lighter body may be made the hottest; as oyl which is lighter than water, is susceptive of more heat upon account of the adhesion of the parts which hinders it to go off so soon in vapour. Molten metals are capable of receiving a much greater degree of heat, except mercury which is an extraordinary metallic sluid, which a small degree of heat dissipates. Air is susceptive of different degrees of heat, according to its different degrees of density; therefore it is hotter in its lowest parts, near the surface of the earth where it is more dense, and colder in its upper regions where it is rare: Hence it is, that snow lies upon mountains, when it thaws in vallies; hence it is also, that snow, frost and hail, are generated in the upper regions of the air (p).

Water also is susceptive of a greater degree of heat, at one time than another. When the atmosphere is weighty and presses most upon water; water is then capable of the greatest degree of heat, when the atmosphere is light, water is susceptive of a less degree: In any other respect the heat of water, cannot be increased beyond that which belongs to it in a state of boiling which in the same atmosphere is always the same.

The degrees of cold which bodies are susceptive of, is also in the same proportion. Marble is susceptive of more cold than wood, and metals are susceptive of more cold than marble.

Fire lies concealed in water and ice, tho' feemingly contrary to its nature; by collision it may not only be struck out of slints, but also out of ice, and broken waves in a storm emit a considerable quantity of it. The atmosphere abounds with fire, which the frequent phænomena of meteors and lightning sufficiently demonstrate.

H PRO~

(p) There are other circumstances to be considered in producing these effects. The vallies are hotter than the tops of the mountains, for other reasons besides the greater density of the air below; the vallies have both the direct rays of the sun, and those also which are restected from the sides of the mountains, but the tops of the mountains have only direct rays. This difference of heat is so considerable, that on some mountains snow lies perpetually; and in travelling over the Alps, a man may be in cold, barrenness, and snow, one part of the day; and in warmth, verdure and sertility another part of the same day.

PROPOSITION 14.

Fire separates the parts of some bodies, and unites the parts of others.

DEMONSTRATION,

The common culinary experiments of boiling and baking shew this; For by one a fluid is agitated into vapours, by the other it is brought to a firmer consistence. Different degrees of fire have different effects, by one degree, plants shall burn and partly go off in smoke and vapour, and the remainder in the form of ashes, shall be disperst by a small wind or washt into the earth by rain: by a greater degree of fire those ashes shall become a glass, incapable of dispersion by wind, or of dissolution by water. Hay fet on fire commonly vanishes partly in air, partly becomes alhes: But a great quantity of it taking fire some years past, at the barracs of Dublin, the intenseness of the fire vitrified the ashes. Kelp which is to much used in the manufacture of hard loap, linen, and glass, is no more than the salts of a plant common upon the sea shores. The plant by fire is first reduced to the state of a boiling clammy fluid, by continuance of fire it becomes hard cakes called kelp, this by a mixture with land in a more intende fire, atterwards becomes glass. So then one degree of fire preserves the plant in the form of a plant; another degree changes that form into that of a clammy fluid, and preferves it in it; another degree changes that form, into that of hard cakes or rather stones, which must have a certain degree to preserve them in that form; another degree changes that form into that of glass, which also must have a certain degree to preserve it in that form. For since by the former proposition, fire is in all bodies, and it must be in all states and forms of any body; by this instance it appears plainly to be a principle of union and difunion, according to different degrees of it.

Other plain instances of these properties may be given.

One degree of fire keeps water fluid, a less degree suffers it to become ice, and a greater degree than the former disperses it in vapour. Lightning which is an extreme subtle fire, has prodigious effects in the dissolution of bodies. It can instantaneously melt the bones of a hu-

man body, and not deform the flesh, it can melt a sword and not damage the scabbard. An extraordinary instance happened in this kingdom, in the year 1707 (q), and a later instance in the county of Tir-Owen, in 1749. A ball of fire descended into the kitchen of a gentleman's house by the chimney, and rolling on the floor divided into two parts: One part being self extinguisht became water, the other darted through the cieling, where some of the family were sitting, and the ladies at work, particularly a mother and a daughter, both holding seissars, just in the act of delivery of them from one to another; the daughter was killed, and part of the seissars melted; the rest of the company escaped.

The other story being related in the philosophic transactions, I refer you to it; only remarking that the lightning penetrated through the roof of the house, the sloor, and three hundred and fifty folds of linen, making a hole of a square form, broke, killed, and scattered many things.

PROPOSITION 15.

Fire not only takes place in every body, but exists also in places almost totally vacuous of other matter.

DEMONSTRATION.

Two sticks rubbed on each other with a strong pressure for some time, may be made to take fire and blaze, which often happens in the axle trees and naves of carriages. Iron by friction may be made red hot: A cannon bullet receives a considerable degree of heat, when it passes through the air; and gunpowder has been fired at the bottom of the sea, in a machine contrived for the purpose, into which neither water nor the external air could penetrate. And the INQUIRER remembers particularly, when some iron guns were landed some years past on the custom house whars, in Dublin, which had been part of a wreck of one of the Spanish Armada, taken up by Divers lately upon the coast of Scotland; that the metal was corroded much by rust, but changed so as to be capable of being reduced to a black powder, like black lead crumbled,

⁽⁹⁾ A place called New Forge, on the river Lagan. See Phil. Trans.

and that, merely by striking it with a key; a small quantity of this fier carried home in a paper grasped in his hand, which grew so hot during the walking the length of three streets, as almost to become intolerable.

The vacuum which is made in the top of a Barometer by well depurated quickfilver is more free from matter, than perhaps any that can be made by fuction in the air pump. For air being an exceeding elastic body, is almost in the smallest portions of it capable of such expansion, that although by every suction some air is discharged, what remains expands itself and becomes thinner, and cannot be totally exhausted: But the Barometer or tube of glass being filled with well cleansed mercury may be inverted, to let the mercury subside; there is then as vacuous a space lest above, as human art can make: Yet by the agitation of this mercury, the end which was open being stopped, and the tube being often turned, so as to make the mercury move from end to end, a light may be excited in the vacuous part of the tube.

It is probable that fire is extended all over space; although it is discernible by its effects only in some parts. When the rays of the sun are collected by a mirror or burning glass, and thrown into a socus, the heat of that point is prodigious, which suddenly melts or consumes bodies; yet if paper be held between the glass and the sun, that fire instantly vanishes; but whither? Not out of nature, for the rays of the sun are real matter, and can not be annihilated without a miracle: They are therefore still existing, the all sensible effect has ceased. Hence we should infer, that it is equally possible for fire to exist unperceived

by us in any other points of space.

The late experiments of electricity, seem to prove an universal stery ather? and although the exertion of the influence of this ather upon gross matter are not at all, or very imperfectly known, yet the extent of its influence being unlimited, proves the athereal fire itself to be so (r). Perhaps suture diligence and nicety of observation, may bring many secrets to light, of this kind, and open some pages more of the volume of nature, to those who are disposed to read it. For this study can never be exhausted; to him who has travelled farthest in it, there

⁽r) Concerning the Analogical application of this to Theology. See the Analogy of Divine Wisdom, in the Material, Sensitive, Moral, Civil, and Spiritual system of things, published last year, by the Author of this book.

fill appear large fields quite uncultivated, too much for human abilities, or human life, tho' it was protracted to any antediluvian length. But fo is every thing about which human nature is concerned, or indeed ought to be concerned. Human appetites of all kinds are unlimited, when unrestrained by reason: whether they regard knowledge, or riches, or power, or life. Yet a pursuit of these things (never to be obtained so as to satisfy the greediness of desire) is praise worthy, and the duty of every man, so far as to give the human mind employment, and to keep human nature active.

To the properties peculiar to the elements demonstrated in this lecture shall be annext two properties of matter in general.

PROPOSITION 16.

All matter is in absolute motion.

This globe of earth in turning upon its axis, moves every part of its matter with great rapidity, and those upon its surface are moved at the rate of one thousand miles an hour, or more than fifteen miles a minute; but as it moves round the fun in an elliptical orbit, differing very little from that of a circle, whose diameter is one hundred and fixty millions of miles, it must move at a more rapid rate, than that of one million of miles a day. And leeing that every planet moves round the lun, in a less or a greater orbit, and in a less or greater time, and consequently with a less or greater motion; and every sun revolves upon its own axis, every particle of matter must be in real absolute motion. Notwithstanding this the relative situation of many bodies, continuing for many ages the same, may hastily incline some persons to think that abundance of the matter, at least of this our globe, is at rest; but a demonstration of what has been just afferted, for which we refer to aftronomy, is a demonstration of this universal circumstance of matter: By this is not meant, that motion is of the nature of matter, or inteparable from it: For matter is indifferent to motion or relt; and as it can not move itself, so neither can it stop itself, being by nature inert, that is, incapable of action, which must always arise from intelligence. We

mean

mean in this proposition only, to demonstrate one circumstance of the state of things, to wit, that all matter is in real absolute motion.

But the proposition principally means the matter of this globe. Now this globe has not only a rotation upon its axis, and a rapid annual motion in its orbit as described, but all the parts of it within themselves, have an infinite variety of intestine motions: Like a ship under sail, impelled by the wind at the rate of three or four leagues an hour, whilst within an inconceivable number of motions may be performed; fome conspiring with the motion of the ship, some seemingly directly contrary to it, others in various degrees of obliquity. Most of the matter of this globe, perhaps all, has an intestine motion, whereby some particular private phænomena are produced or preserved, besides the general motions belonging to each mass. The air is in a perpetual oscillatory motion, being subject to momentary changes of influence from the sun; fire or æther feems to have fo much motion as to be the instrument of motion to every thing material: Water, whether in the form of springs, vapour, rain, rivers, lakes or feas, is ever moving; and even when in a fedentary state, according to the vulgar manner of expressing things, it has the motion of corruption, and as it were, quickens with animal life, and thereby acquires a new kind of loco-motive power within itself. And as a great partof the matter of this globe, belongs either to animals or vegetables, all such matter must be in motion, for growth implies the motion of blood or fap. The great Mr. Boyle has observed with extraordinary nicety, that the spots in precious stones have changed their places, and performed as it were periodical revolutions, and the natural stains of marble have been observed by many to have changed. For earth can not be a fluggish motionless element, when the other elements with which it must hold perpetual commerce, are employed in functions, which require motion. All matter therefore is in absolute motion (s) Q. E. D.

(s) Notwithstanding this, the propriety of speaking of some particles of matter, as being at rest must be allowed: For if men in a ship which is under sail, sitting round a table may be said to be at rest, in respect to the offices of working the vessel, although they move with the ship, and the blood and all the parts of their bodies move within themselves, so in many respects we may speak properly of matter, as being at rest. Sir Isaac Newton is obliged to use the terms the force of bodies, although he informs the reader that bodies have not force, being only capable of receiving impressions, and yielding to force which intelligent movers give.

PROPOSITION 17.

All matter is extremely porous, that is, every mass of matter contains within its furface, more space that is void of matter, than that is filled with it.

DEMONSTRATION.

The gravity of all matter being supposed as a property not needing proof at this time; it is plain, that the weight of all bodies must be in proportion to the quantity of matter contained in equal spaces; and the more matter in any space, the greater is the weight of that mass: And fo in the converse, the greater the weight of any body, compared with another of the same dimensions, the greater quantity of matter it contains: so then all lightness is no other than vacuous space, within the furface of matter, and weight is no more than matter occupying space in a more or less compact congeries. Now gold of all kinds of matter being the heaviest in specie, must also contain more matter within the fame limits of space compared with other bodies. Yet gold (t) is found

(t) Sir Isaac Newton shews, that bodies are much more rare and porous, than is commonly believed: Water, e.gr. is nineteen times lighter, and consequently rarer than gold; and gold itself is fo rare, as very readily and without the least opposition, to trans-" mit magnetic effluvia, and easily to admit quicksilver into its pores, and to let water pass through it. For a concave sphere of gold hath, when filled with water, and soldered up, upon pressing with a great force, let the water squeeze through it, and stand all over its outfide, in multitudes of small drops like dew, without burfting or cracking the gold: Whence it may be concluded, that gold has more pores than folid parts; and by consequence that water hath above forty times more pores than parts. Dictionary by Chambers, in the word PORE.

If water can not be made to pass any where by artificial force, when gravity or attraction alone would not be fufficient for the purpose, the foregoing experiment is liable to exception, and it may be faid that the water passed through cracks or fissures of the metal. But not to dwell upon these circumstances, let the truth of what is asserted in the proposi-

tion be determined, by the ingenious John Keil, Lect. 5. Theor. 2.

That all bodies are very porous, that is, contain but a very small quantity of matter, in respect to their bulk, is most certain from the properties of diaphanous bodies; for the rays of the light within glass or water, are insused in right lines as well as in air, whatever

Popular LECTURE II. 46

found by naturalists to have abundantly more vacuous space in it, than folid matter; and consequently all other kinds of matter, specifically lighter, have a fortiori more vacuous space than gold; but vacuity of space is what we call pore. Therefore matter of all kinds is extremely porous. Q. E. D.

- fide of the diaphanous body is exposed to the light: And therefore from any the least
- affignable part of the diaphanous body, to any other part of it, there is always extended
- in these bodies, a rectilinear pore; through which the light may pass; and this can not be, unless the matter of the diaphanous body obtains but a very little proportion to its
- bulk; and perhaps the quantity of matter in glass, has not a greater proportion to its mag-
- is nitude than a grain of fand, to the whole bulk of the globe of the earth: But that this is
- ont impossible, we have shewn above. Whence fince gold is not eight times denser than glass, its matter also to its proper bulk, bears but a very small proportion.

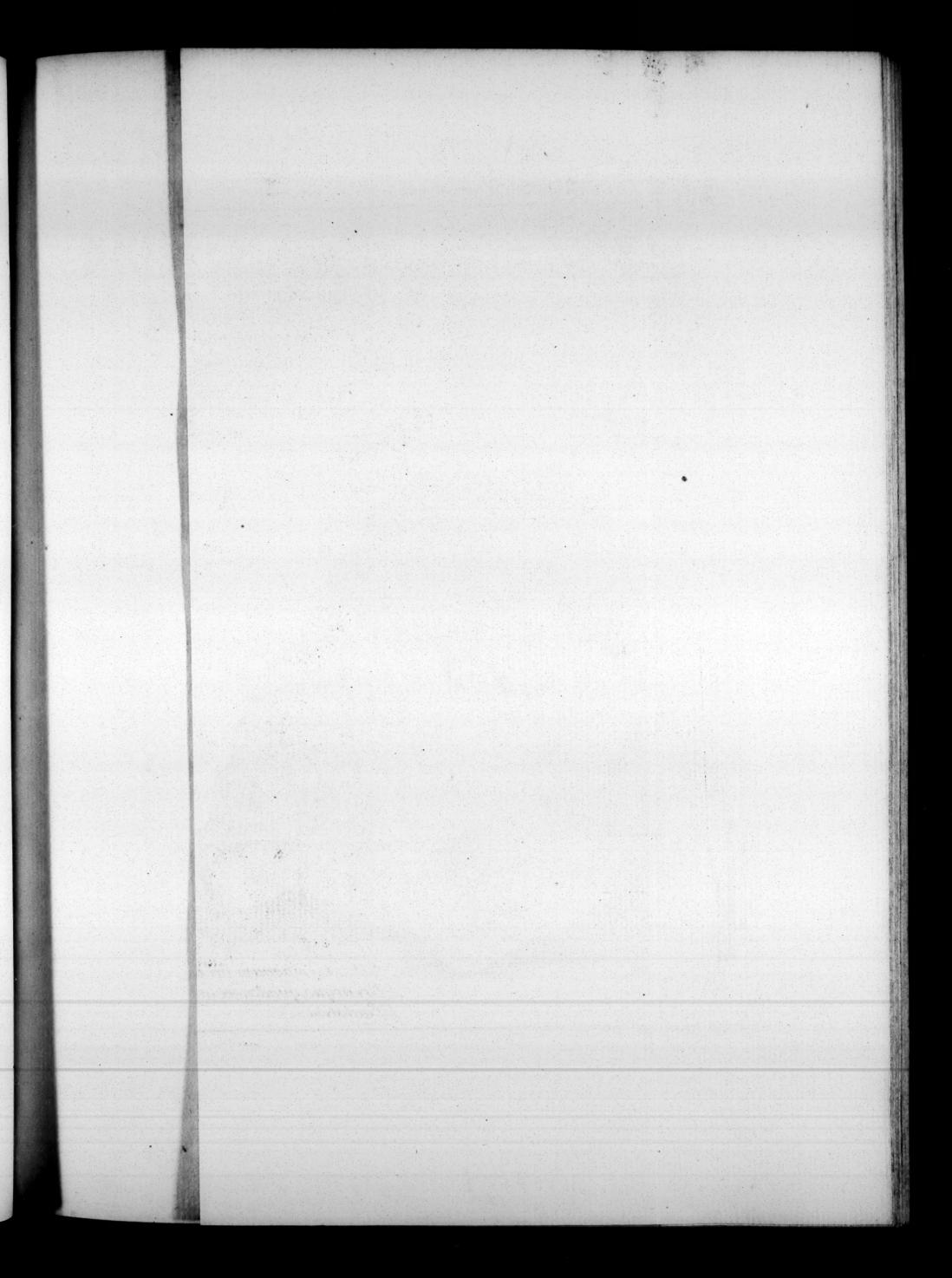
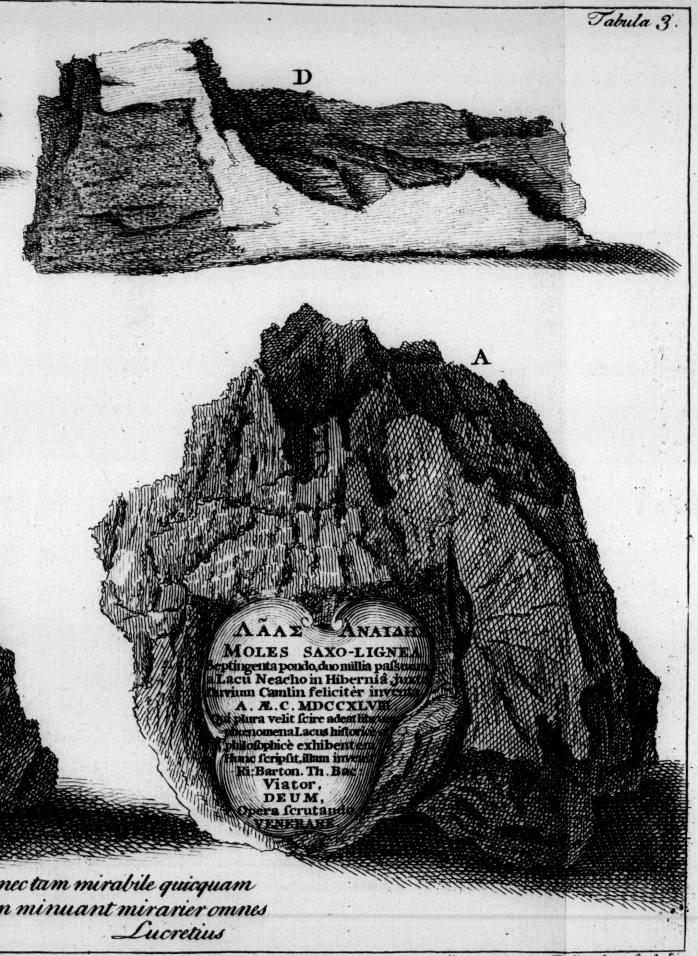
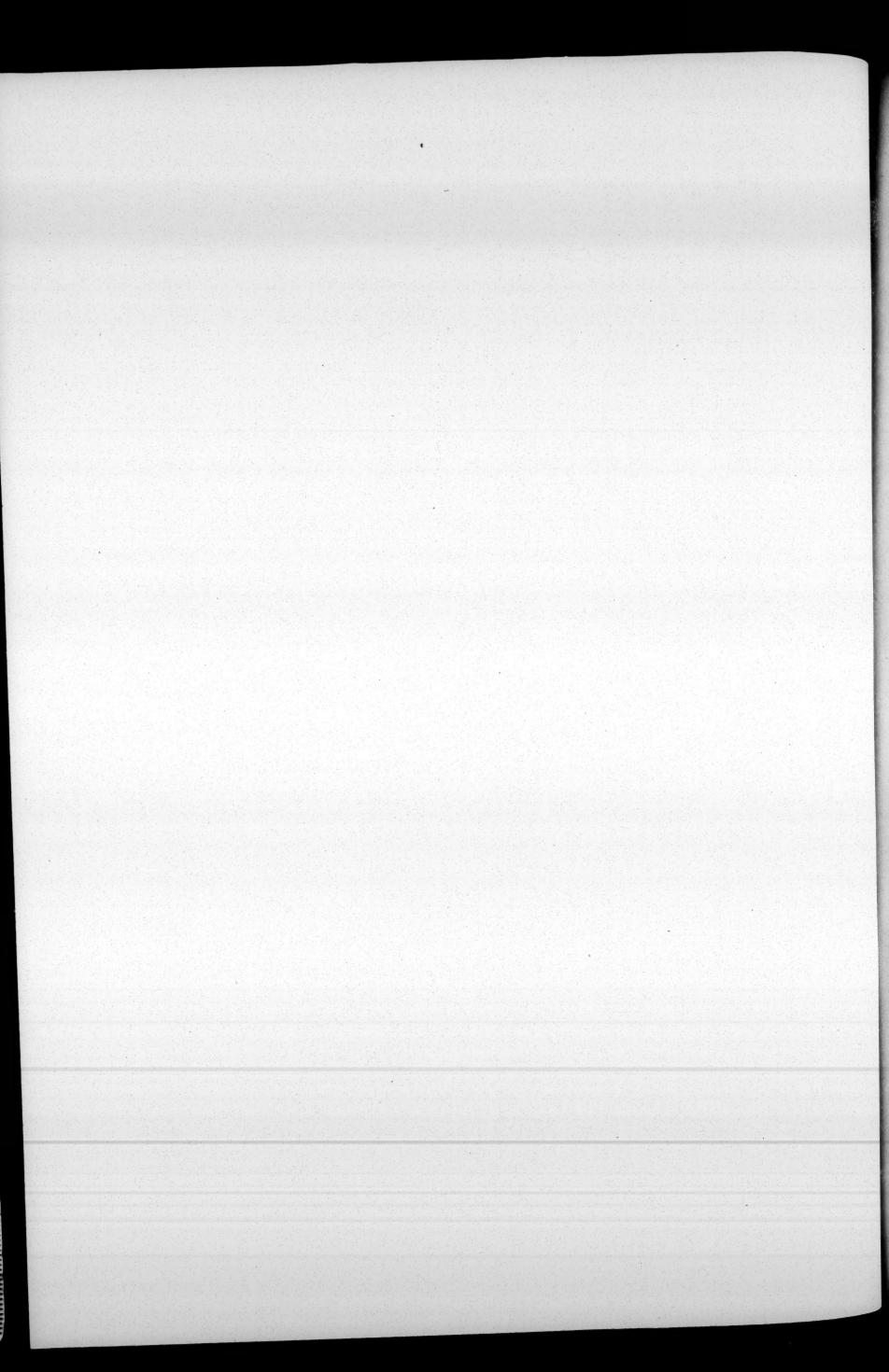


Plate 3. P. 46. fronting Lect. 3. Nil adeo magnum nec tam Brincipio, quod non minu Laulatim



T. Chambars feulp!



LECTURE

OF

METAMORPHOSES,

Or a CATALOGUE of

SPECIMENS

OFTHE

Transmutation of one sort of matter into another.

Alfo a CATALOGUE of

GEMS and CRYSTALS found on the Shore,

AND IN THE

Neighbourhood of LOUGH NEAGH.

LECTURE III.

Sedebat In solio Phœbus claris lucente smaragdis. Ovid Met.



ADVERTISEMENT.

ONFIDENCE in a writer is always disagreeable to a reader: Because readers may have as good an opinion of their judgments as the writer has of his, and would rather feem to teach themselves, than be taught by any one. The Inquirer therefore is quite averse from giving any opinion in his book with a confident affurance of its truth; he only defires to shew upon what principles of reasoning he founds his judgment, which he has in great measure done in the foregoing Lectures, and if the same degree of evidence appears to others, when these principles come to be applied to the phænomena treated in the following Lecture, the consequence will be the same opinion. But whether his reasoning be upon true principles or not, or whether the application of them to the phænomena be just or not, the phænomena themselves, of which the catalogue follows, as necessary to be perused before reasoning can be founded upon them, is a valuable discovery; and the credit of this, it is hoped, the reader will not refuse him. Honesty is what should always belong to human nature, because every man can give this to himself: Ingenuity is a divine gift, and is not the talent of many. As a natural historian therefore, he hopes, to have credit with those, whose distance from hence will not allow an ocular view of the specimens. For the annext catalogue is intended for the use of foreigners; by foreigners are to be understood, all those, who are out of the reach of an ocular inspection, wheresoever they shall be deposited: And that, it is hoped, will be in the Chartered Society of fome state in Europe, who will give a reasonable price for them. At present they are deposited in the musæum of the Rev. Dr. Richard Pococke, Archdeacon of Dublin, and fellow of the royal Society; whose collection,

ADVERTISEMENT.

collection, relating to many branches of knowledge, from Syria, Egypt, and the Archipelago, whither he travelled; as well as in the island where he lives, would give some honour to our country, if the world was made acquainted with it. The Inquirer wishes, that this gentleman would pursue his laudable design, and that others being hereby apprized of it may contribute to it. As many specimens as could be spared, without incroaching upon the foundation of this book, are given to

inlarge that worthy gentleman's collection.

There are above one hundred specimens more, which are extremely well worth viewing, yet are omitted in the printed descriptions; lest the reader should think himself too long detained, from the principal matter of this book, to which this, and the preceding lectures are only preparatory; and therefore only some descriptions taken here and there from the different classes, as most necessary to the main design, are exhibited to the perusal of the reader. In as much as the place has been already mentioned, where the whole collection is deposited, till some eminent purchaser shall lodge them in some necessary repository of more permanence, than private property can be supposed to be, the curious may have recourse to them for ocular, and more general proofs of what has, and shall be said of them.



LECTURE III.

ΛΑΑΣ ἀναιδής MOLES SAXO-LIGNEA, plate 3. page 46.

HIS wonderful faxo-ligneous mass, is extremely hard on the outside, emitting fire upon collision with steel in great plenty: Yet has it wood, which is very soft, internally. C, D are two surfaces of a fragment of it, broken with a good deal of labour, from the part where there is now a cavity in a^* ; this fragment has wood in it, in the line bc: and is a strong presumptive evidence, that more wood lies concealed within the stone. A good deal was picked out of that cavity by the curious, who first saw this specimen. The weight of the stone, before the small fragment was separated from it, was seven hundred pounds, being weighed at the public crane of a market town.

The colour of this stone in the surface is white stained with yellow, this being owing to a bed of yellow gravel, in which it was sound, and part of which is to be seen pressed into the little crevices. For the true external colour is white, like that of a firm kind of chalk; but the matter which affords this colour is very thin, not exceeding that of an English silver penny, and capable of being altered by rain; for when it is wet, the stone in some parts appears of a blue colour. The internal part of the stone is a dark grey, that is, any part which is exposed to view, by the breaking, which likewise would appear blue, was it brought to as smooth a polish, as some parts of the external surface. It was found two miles from the lake, on the side of the river Camlin (v), above the surface of the water, which at that time was very

⁽v) See-the frontispiece of this book.

^{*} A and B are two faces of the same mass.

low, about three feet, it being a perpendicular bank of gravel, with a small mixture of yellow clay, and under another perpendicular bank of the fame kind of gravel, about fix feet high. The perpendicular parts of these banks, were barren gravel as if newly broken, yet above was good grazing ground, and below was a skin of grafs incompassing the flone, which lay almost totally immersed in the bed, in the posture in which the stumps of anciently decayed trees commonly appear. Although it has the evident appearance of a stump of a large tree, including part which should be under ground, yet is there no appearance of roots extending from it, nor did the bed afford any evident indication, of there ever having been any more of the tree, to which it belonged, in that place. Therefore this was not its native bed; for otherwise there would have been at least, some vestigia of the roots either in the form of wood, found or rotten, or of wood metamorphosed into stone, as this mass for the most part is. Its white surface is an indication of its having been long exposed to the fun or open air; because all the specimens hereafter described as found above ground, are of that colour, and thole found under ground, are black. It may be proper to inquire how this mass was brought hither. It is well known that rivers subject to floods, or more properly montaneous torrents frequently roll large masses of matter along with them: if it be clay torn from its stratum, it breaks it by frequency of collision in its motion, and dropping here and there the weightiest of its constituent parts, forms bottoms of gravel in the channels of rivers, but the lighter parts being longer born up are carried further, and make shores of sand to lakes, and to harbours of the sea: Where the water spreading themselves, lose their force, and the fand fubfides and forms BARS, always more or lefs incommodious for shipping. The earthy parts being capable of more comminution than fand, are also capable of longer suspension +; and either subside later, and are perhaps soon disturbed again, or are carried into the sea, and by a diffusion with that immense mass of water make part of its nature; are born up into the air in vapour, and restored again to the earth, in rains, dews &c .- For all these have earth in them. But large masses of matter, such as this specimen, not capable of easy comminution, are, when violently torn from a native bed, foon interrupted by obstacles, such as rocks, trees &c. and being rolled

on the uneven bottom, upon account of the weight; many angular parts and prominences such as roots, must be broken off.

The native bed therefore of this faxo-ligneous mass, is not far from the place where it was found, and search might be made for it very near, if the proximity of a fall in the river, which is marked in the map (x), and represented in the frontispiece of this book, did not shew the possibility of its being easily rolled down that space, which being a gradual declivity of considerable length, aided the force of the flood.

A Clergyman, fince dead, whose station being in this neighbourhood, gave him frequent opportunities of wading in this river, for he was fond of fishing, informed the Inquirer, that he often stood upon an extraordinary mass of matter, in a particular part of that river, which he used often to admire, but being more of the rural sportsman, than the philosopher, he did not examine into it. Being removed thence forty miles, when he related this, he promised to shew the place, whenever he went into that country: Death preventing this, deprives the Inquirer of the ability of information in that particular, for his own searches did not succeed.

Let it suffice to say, that search must be made, according to the course of the river, at greater distances from the lake, and that the lake never had any instrumentality in the production of this rare phænomenon: Because its water at the highest never reached this place where this specimen was found.

A latin inscription is cut on this stone with two designs, as well to perpetuate the knowledge of the discovery, with regard to time, place and other circumstances, as to discover the true qualities of the matter. The workman informed him, that he never cut a stone which was so injurious to tools before: For although he had cut stones that were harder, yet none of them took off the edge of steel so son; and almost at every stroke he could show to the naked eye, the glistening particles of steel upon the stone, as well as the injury done to the instrument: This was in the rough work necessary to prepare the shield for the inscription; in half an hours time he spoiled ten tools, which were rendered use-

⁽x) See Plate prefixt to the following Lecture. Numb. 1. at i; also the Frontispiece.

Metamorphoses LECTURE III.

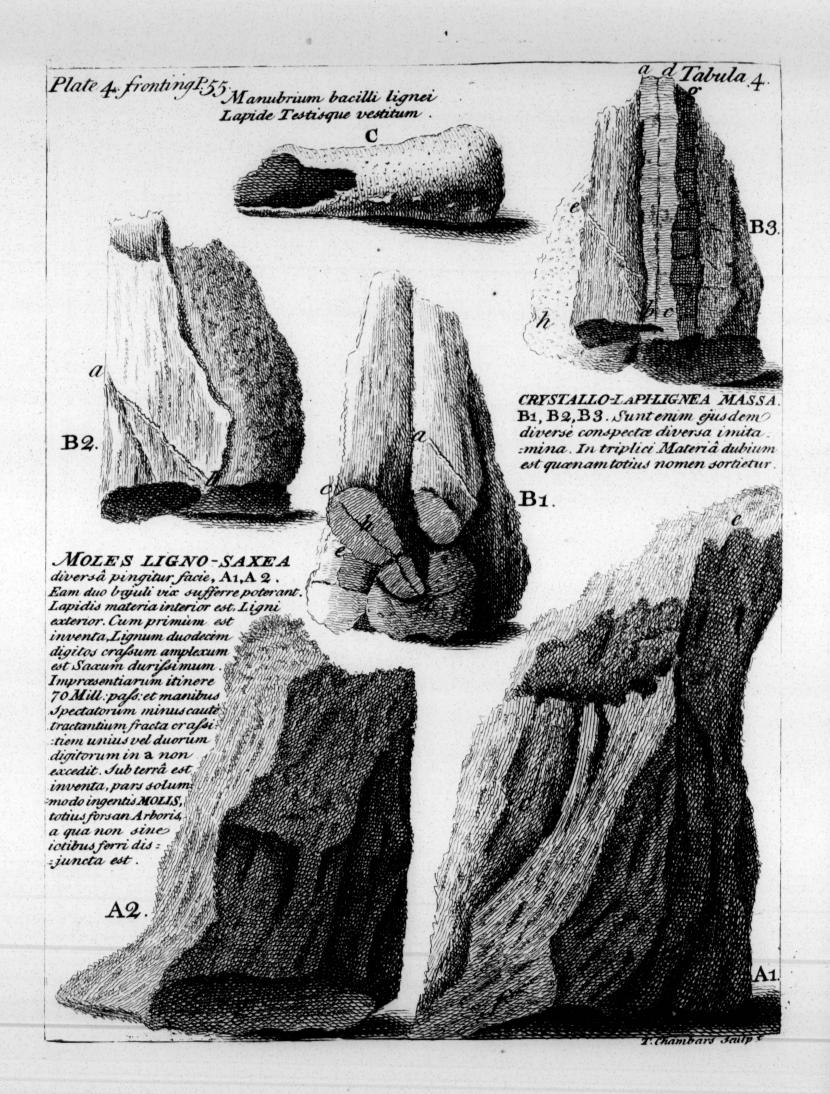
less without sharpening, and was forced to get another set. When the letters were cutting, he observed little lines of crystalline matter, scarce perceivable to the naked eye, which were so extremely hard, as to occasion gaps in the steel: And in many places, he said, he sound it very brittle, in reducing the part designed for an inscription into the form of a shield; for it often split into little chips like wood. This was not an artistice to inhance the price of the work, because an agreement was made before hand for the execution.

C and D are two representations of the fragment, broken from the top of the large mass, at a. And because this fragment has wood in it in the line bc, the large mass in all probability, contains internally a good deal of it: For there may now in the same place be picked out with the point of a knife some wood, although in two years time since the finding the specimen, this has been often done to satisfy the curious.

Number II. INGENS LIGNO-SAXEA MOLES. plate 4.

This mass of wood and stone continuous is as much as two able ment can lift in a frame, whose joints are strengthned with iron. For being carried above sixty miles by land from the lake to the capital of the kingdom, and being the reverse of the former stone; wood on the outside, and stone within (intra quoque viscera saxum est) it was necessary to frame it, that it might be fixed in so steady a manner, as not to lose by friction the tender part of its substance, which lay on the outside: Yet some did fall off, and the hasty curiosity of many gentlemen, laying hold of the ligneous part uncautiously, occasioned much more to fall off; in so much, that whereas the wood lay on every part of this large specimen, at least one foot thick, except at the ends, where it was broken in the raising from a similar mass, to which it was continuous; it is now only two inches thick in any part, and perhaps in a little time may be much less, as the curiosity of many persons remains to be satisfied,





who are defirous to have ocular proof of these phænomena; and will not be satisfied with merely seeing, but will handle and break it.

A 1. A 2. are two faces of the same mass, ad is wood adhering to stone, and of a dark brown colour, c is also wood; all the rest of the mass is very firm stone, b and e being the irregular end of different colours, which difference is not so much the nature of the stone, as the accretion of dirt in the carriage: from b to f, where wood lay very thick, when the specimen was found, there are only thin silaments here and there adhering. The surface of A 2. is for the most part wood, g is the appearance of the stony part in the lower end.

Number III. INGENS LIGNO-SAXEA MOLES.

This stone is as much as a strong man can carry, and is so like the former, as to need no further description; being classed here merely upon account of the place where it was found, about ten miles distance from the former, and in a river about two miles from the lake. The river is that in the maps which passing through the town of Antrim, there enters the lake. When this specimen was found, the quantity of its wood, exceeded that of the stone.

Number IV, V. DUÆ INGENTES LIGNO-SAXEÆ MOLES.

These two specimens are classed together, because they were one solid mass, designedly split with a sledge, in order to discover the inward texture, which is a mixture of very hard stone and wood, together with some of a brittle nature, some more sirm, and more approaching to the nature of stone: The external surfaces differ very little from the external appearance of the two former specimens; the stony parts of these four last specimens, are black. It should be remarked that this solid mass, bore above forty strokes of a sledge of 16lb. weight before it was split.

Number

Number VI.

A fragment of a very large mass, being as much as one horse could draw, most of it wood, which breaking in the carriage, no more of it is reserved for this collection, than about 50lb. which being heavier than weighty wood of the same size, denotes that there is stony matter within, of which there is one part plainly discerned, being continued to the surface, appearing very hard and sonorous upon the stroke of a hammer.

Number VII.

This stone is near twenty inches long, and five broad; one side is ground to a stat surface, is a firm black stone, and gives a knife a good edge; the other side is wood, and may be cut with that knife in several places, without spoiling the edge. N. B. There was a great quantity of wood, which was broke off in the grinding.

Number XX. LAPIS HOMOGENEUS.

This stone is a fragment of a much larger stone, altogether of one kind, hard and emitting fire plentifully even upon the friction of another stone; sometimes water has been poured upon it, and in drawing another stone of the same kind upon the surface with a quick motion, almost a line of sire has been made, the sparks came forth in such plenty. It is ground to four surfaces, which are good for whetting knives, but not equally excellent. Although it be altogether stone, yet has it still the visible appearance of wood. The bending of the sibres often seen in the grain of timber, being very discernible in it, as well as the rings of annual growth in the end. It is a mixture of the black and white kind of stone, the white being worn away in several places, by grinding the surface. It weighs about 12lb.

Number XXI. A.

Another of the whetstone kind about five pound weight, having only one furface ground for that purpose. The circumstance most remarkable in this specimen is, that there appears one large straight sissue, running

Metamorphoses L E C T U R E III. 57

running the whole length, which is fix inches, and the breadth, which is four, filled up with a lapidescent matter, which like glue seems to cement two stones, rather than to carry on the continuity of the parts of one: And at each end there appears, besides this fissure which extends the whole length and breadth, other irregular fissures, three at one end, two at the other, filled up in the same manner; as if a piece of wood was by some violent force squeezed, so as to cleave in several places, and was by an influx of lapidescent matter, not only converted into stone, but had all the cavities filled with it. When clean grained timber is violently squeezed at the ends, or sides, especially when lying in heaps in the natural form of a tree which is round, it is very capable of cleaving: For there are insterssices, into which the unprest parts may recede, till the whole mass becomes close.

Number XXI. B.

This specimen is ground into a whetstone form, and has not only the white light gritty stone externally, and the black stone internally; but several streaks of iron ore, passing quite through it lengthways: On one surface are two of these, which are the most conspicuous, one is straight, the other a little curve: On the opposite surface, they both are curve. This heterogene matter was collected here upon cleaving the wood as above described.

Number XXII. XXIII. LAPIDES HOMOGENEI.

Two whetstones of the white kind; possibly within there may be some part black, but, although they be pretty deeply ground, nothing black appears except a little streak in one of them.

Number XXIV, XXV.

Two fragments of one long whetstone of the white kind, which was two feet long, two inches broad, and half an inch thick, being broken into several pieces in the carriage: The internal texture is exposed to view, which is white like the surface, with a small streak of the black stone in each: Some parts rubbed in the carriage whiten the hand like chalk.

K 2

Number

Number XXVI.

This is a whetstone, which as Mr. Anthony Shane apothecary, who was born very near the lake, and is now alive, relates, he made by putting a piece of holly in the water of the lake near his father's house, and fixing it, so as to withstand the motion of the water, and marking the place so as to distinguish it, he went to Scotland to pursue his studies, and seven years after, took up a stone instead of holly, the metamorphosis having been made in that time. This account he gave under his hand writing. The shore thereabouts is altogether loose sand, and two rivers discharge themselves into the lake very near that place.

Number XXVII.

This is not ground into a whetstone, not being of a proper shape; but it is classed here, upon account of the evident tearing of the ligneous sibres transversly, and very irregularly, before the metamorphosis intostone, which it now is become almost intirely. For when timber falls promiscuously in a heap, some pieces will lie parallel, and some transverse, and some almost upright, and in all manner of directions.

Number XXVIII. A. B.

Two fragments of one mass, in which the crystalline matter appears in different forms. In A, in many small fissures, according to the sibrous directions of the wood now become stone, but in one part, where they are broken transversly, it appears intermixt with black, so as to exhibit a grey colour. N. B. This crystalline appearance is never observed dispersed through the woody part of the masses, although a small slice of wood has been observed incompassed with a cluster of crystals, lying upon the inner surface of a cleft of a large mass (a).

Number

(a) This leads to a proof, that the matter of these stones is for the most part crystal.

Number XL.

This is a specimen of wood alone, which tho' found in the bed of mixt matter, hereaster described in the historical lecture, has undergone no change in respect to petrification. It is what workmen call burry, or cross grained, yet it admits a plain, and is thereby reduced to a smoothness; there is another mass of similar matter in the same class, being altogether wood, and cleaves easily according to a straight grain; both these cause a pleasant smell in burning.

Number LI.

Shews the crystalline matter, concreted with a mass of small crystals, at the inside of a mass of mixt matter, wood and stone. (b) A is the external surface, being sirm stone, B is part of the interior mass, being almost an equal mixture of wood and stone, of a dark brown colour, inclining to black, like many others of the same kind; the part C is entirely a cluster of small transparent coloured crystals.

Number LII.

This is a curious congeries of mixt matter, extremely rough and irregular in the furface, having the white colour peculiar to stones long exposed on the shore, but very much dirtied by a kind of froth, observable in some, like barm in colour, which is dried upon the greatest part of the surface. The mass being broken, exposes to view the part A an extreme hard black stone, with a few streaks of crystalline matter; as well as some glistening matter equally scattered through the black: In the neighbourhood of it, is a cavity very irregular, being lined with a rough concretion of matter, partly sand and partly crystalline matter, in tubercles, wherein the crystalline matter glistens; in the midst running the length of the cavity, is a thin prominent slice of mixt matter, the external part of which is sand concreted into small tubercles, and the internal part

⁽b) A and B are written on paper and pasted on the specimen, as well as other letters used in these descriptions.

Number LIII.

A small specimen shewing the crystalline matter running transversly, also a cavity with regular formed crystals.

Number C.

A stone burnt in a culinary fire, which at first emitted a faint slame, but although frequently burnt afterwards, emitted no more slame, but grew red hot, and when cooled had always the same visible appearance, which it has now, being white in the surface, and black inwardly, intirely resembling charcoal. N. B. upon breaking this stone, so as to expose the internal parts, to the immediate influence of the fire, the parts immediately exposed would become white, for this was tried in other instances.

Number CI. A.B.

The specimen A is burnt in a culinary fire, and shews a near resemblance to B, which was not burnt except by the solar heat upon the shore; in both these may be seen a rim of white matter, incompassing a seemingly black charcoal within.

Number

Number CII.

A burnt specimen wherein some crystalline matter, still retains a glistening appearance, tho' not formed into crystals, but disperst irregularly through the black part of the mass.

Number CIII. A. B. C. D. E.

A mass found upon the shores, which by rolling as the water moved it, is worn into a form something orbicular. Its surface is white, and where a crack, almost invisible; allowed most free access to air and solar influence, the opposite sides are white, as appears by breaking it in that part; but the rest of that mass internally is almost black. B is a small specimen exhibiting the same appearances, and also, the crystalline matter irregularly disperst and glistening. C is a specimen wherein all these things are more discernible; and D is a specimen singularly remarkable in this respect: It is a small fragment of a large mass, which being placed in building as the upper corner stone of a small country house near the lake, it is almost intirely become white, having probably been exposed to the weather in that situation above thirty years. E is a specimen which has been several times in a culinary sire, it has a good deal of iron ore, which being scraped, where it appears in red striæ, readily leaps to the magnet.

N. B. Some of the specimens of wood petrifyed, so as to be totally converted into stone, were put into the fire, and after becoming red hot, were taken out and weighed in water, and weighed again after imbibing the sluid: from which it appeared, there were some combustible sibres of wood, which were consumed by the fire, and thereby gave admission to the water, except in one specimen of the white kind, which being totally converted, suffered no alteration; for it is elsewhere remarked in these lectures, that the perfect stones of this kind bear a very intense heat without susion or calcination.

Number.

Number CLI.

Five specimens seemingly converted totally into stone

veighed after		after lb.	imbibing oz.	water.
A 4	8	4	15	
B 4 C 2		4		
D_{1}		2	9	
E			15	

Number CLII.

A vitrified crucible and burnt stone, described in the following experiments.

Experiments made for the Rev. Mr. BARTON.

I powdered finely two drachms weight of the stony matter, and the same weight of the woody matter; and put each into two ounces of highly rectifyed spirits of wine—after they had macerated for a week, I found that the woody matter had afforded the spirit a very strong tincture, of as high a colour as common tincture of myrrh, —— this tincture had a very aromatick finell and tafte, and upon putting a little of it into a certain quantity of water, the water became of a milky colour,—in this mixture I found the aromatick smell and taste, more manifest than in the tincture alone.

At the fame time, the stony matter had scarce changed the colour of the spirits, nor could I perceive any difference in taste, or smell, between that and plain ipirits: And upon putting the iame quantity of water as of the tineture in a vial; I found that mixture did not differ in tafte, smell or colour, from a mixture of common rectified spirits and water.

I put the stones you defired to have calcined into a crucible, and gave it the highest heat that an air furnace would admit of, for the space of eight hours; in which time part of the crucible, was vitrified, yet I could not perceive that the stones had suffered the least change.

ROBERT DAVIES.

* The world may expect useful operations in Chirurgery, from the diligence and ingenuity of this young man, whose studies are in that art.

+ N. B. These stones were petrifications of the lake, which had been burnt before in a culinary fire several times, and are to be seen in the collection.

Number CLII.

Friend BARTON,

I have carefully examined that curious production thou wast so kind as to make me a present of, and here send thee the result: It is truly a piece of wood, converted into a bituminous or metallic matter, which if it had lain long enough in its natural bed, would in all probability have lost all appearance of wood in the surface, as it has entirely in the center, even as the matter of petrifications by degrees assumes the shape of vegetables shells &c. But that a bituminous and metallic matter should act thus, is in a great measure new to me, and had I authority enough I would call it a Bituministication.

It is, in the parts that are most transmuted very shining, glossy and black, like a hardened, dry, pitchy matter; emits a white slame, and makes an agreeable fire; and two scruples burnt, left nine grains of black ashes, which by the tryal with the magnet, appear to be chiefly

iron.

Dublin 3 1750.

J. RUTTY.

This gentleman besides honesty and diligence, has many good qualities to recommend him, one especially, that of obliging the world with many useful works, yet industriously hiding from same, which must make him known, when his ingenious performance on mineral waters of Ireland, shall come into the world.

The fequel of experiments on the bituminification, for R. B.

I took a drachm and half of the wood which had suffered but little change from the said matter, but was still chiefly woody: This was by burning, reduced to 12 grains of ashes, which were but very little attracted by the magnet, in comparison of the ashes mentioned in my former experiment, by which it is evident that the assumption of the mineral matter into the pores of the wood is made gradually.

Charles Smith * shewed me from R.B. collections, a black stone: Its infusion shews its vitriolic nature by striking of a deep purple with galls.

L Number

* This gentleman is an useful and pains taking Inquirer, into the Natural and Civil history of his country, and has published the history of two counties Cork and Waterford.

Number CCL.

A fragment of a mass found on the shore.

This specimen shews first the different thickness of the external coat of white matter, being in one place less than a filver penny, and in another, more than double that of a crown piece. The motly appearance in one place to the depth of two inches, of black and white, and also the shining of many particles of crystalline matter, when viewed in sunfhine is worth notice.

Number CCLI.

This specimen shews not only stone internally but also internally intermixt with some fibrous parts of wood, which by rubbing with a moist finger, might be rolled into little cylinders.

Number CCLII.

This specimen shews the external white colour, owing to the sun and air, together with the same colour appearing under the exterior fleak, where there was a communication for the air: A at the infide thews this: B being internally black, thews that the continuity of matter, excludes the air and prevents the stone acquiring the white colour; where there is only a contiguity it does acquire it, as in ACD which was all covered with an exterior fleak, but not in close contact.

Number CCLIII.

This specimen shews that all parts of the wood, which seem to be homogene and free from knots, do not equally admit petrification, there being firm stone in the center, and parallel to that, matter partaking more of wood than stone, and so alternately to the surface.

Number

Number CCIV.

This specimen shews internally such a intermixture of stony and ligneous matter, that it may be doubtful which to call it; because to the sight it appears wood, and when applied to the stame of a candle it blazes a little; and after that being applied several times, it only grows red hot without any sensible waste; the thickness of the white superficial matter also plainly appears, being less than that of a silver penny.

Number CCLV.

This specimen found upon the shore is a fragment of a stone very hard and black, which was worn into an oval form nearly, by rolling along with the water: Upon breaking, it exposed to view, a cluster of small crystals, and also two apartments of wood intermixt with crystalline matter, that shines beautifully when viewed through a magnifying glass.

Number CCLVI.

A specimen of wood, wherein the calcarious matter appears in small lumps.

Number CCLVII.

This specimen shews near A, a concretion of sand in a hollow part of the stone, being a different phænomenon from the stony matter of the rest of the mass which arises from another cause.

Number CCLVIII.

This specimen shews not only wood turned into stone, and wood remaining in part of the mass unconverted, but also some fibres of the wood, the remainder of more wood that was torn from it, which are quite of a different colour from the rest, being white; whereas the firm wood is extremely brown, and the stone is black. The difference of colour at first occasioned some surprize, and raised doubts about the nature of the wood, whether it be or not, what it is suggested to be.

2 Number

Number CCIX.

A piece of cedar bought from a cabinet maker, in which there are two different colours. One part is of the usual brown colour of cedar inclining to red, the other continuous to the former, is white, not unlike ordinary fir deal: One part is as fragrant to the smell as the former.

Number CCLX.

Is a specimen of wood almost totally turned into a vitriolic pyrites. It was part of a very large mass of mixt matter; part wood, part wood converted into stone some feet thick, and several feet below the surface of the earth, in a stratum hereaster described in the historical lecture.

It was discovered when the servant was putting some of the sossil wood upon a chamber fire, in order to regale company with the pleasantness of a fragrant smell, for exciting which, this wood is remarkable, as well as for chearful and durable fire; its extraordinary weight was sufficient to occasion its being taken notice of, and upon examining it had the appearance of a lapidescent charcoal: For matter extremely like charcoal, could be pickt out of it, and the burning of that matter, was also like it. After it had lain by for some time, a considerable hoariness overspread it, the matter which occasioned it being tasted, was evidently vitriolic (c). Yet the mass did not crumble, having still an intermixure of wood.

Number

(c) Aldrovandi mufæum metallicum.

In tractu Elbogano, ad oppidum, quod a planitie Falconum nomen habet inventæ sunt permagnæ abietes lapideæ naturæ una cum corticibus, in quorum rimis pyrites concreverant. Page 854. tabella VIII. monstrat duas icones, quarum prima refert arundinem, seu frusta ejusdem, secunda icon ostendit caulem sæniculi in lapidem duratum; foramen, nodos, venas, et nervos habet, quæ omnia in vegetabili caule sæniculi observantur. Verum non debent aliqui hæsitare, an hic caulis revera fuerit conversus in lapidem, quoniam natura lapides etiam plantas et caules formare potest, cum plantas, quæ vegetabilia sunt persectiora generare possit. Quapropter, in hoc casu, argumentum a majori ad minus probandum, et admittendum est.

These quotations from Aldrovandus shew, that his copious collection of specimens of petrifications, are inferior to the collection of which there is here a catalogue partly given. For many of these petrifications, contain still the ligneous matter naturally continuous to the matter metamorphosed into stone: which must be more convincing to inquirers, than

Sub

Number CCLXI.

B 1 B 2 B 3 in plate 4. p. 55. are three different representations of the parts of the mass, containing wood, stone and crystal. B 1. is the view of one side and one end of the mass; in which ab denotes a line of crystal, cd a crack dividing a mass of crystal of the shape cdef, in which from cd there are, as it were lines of crystal parallel to bf on one side

any argument drawn a majori ad minus. Aldrovandus used that argument, it is likely, because he never saw one specimen of wood and stone naturally continuous. His style in many cases implies this, abieties lapideæ naturæ, and Tab. V. 861. refert expressam imaginem cujusdam frustri lapidei ponderosi, quod fortassis olim suit lignum, and such like. The works of this pains taking writer, were not within the reach of the Author of these Lectures, till they were in the press; at which time he could not search as diligently into Aldrovandus, as others may. But Aldrovandus's accounts are rendered more probable, by what has been related here; Yet perhaps two of the following may be liable to exception.

Majori admiratione teneri debemus, dum res etiam tenellæ, ut fructus, et fungi lapidescant. Habuimus enim fungum lapideum absque pediculo, ex Cairo allatum.——Nam in mari prope Cairum, multa lapidescunt. Mus. Met. 856.

All the marine productions like mushrooms, of which the Author of these Lectures has seen many, and has had the property of some, have the stalk on the opposite side to that which is natural to the vegetable mushrooms of the land.

Tabella VIII. est valde admiranda, quoniam repræsentat triplex lythoxylon, nempè fragmentum castaneæ, quercus et ulmi in lapideam formam transformatum.

Tab. XII. Habet delineatum arboris incognitæ corticem pariter petrificatum, fuisse olim corticem arboris cognovimus, quoniam facile in particulas corticeas scindebatur, quemadmodum aliquando in arboribus observavimus, quarum cortices alium corticem internum amplectantur.

It will be hereafter observed, that all the petrifications which make part of the subject matter of this book, there is not one specimen of bark petrified.

The two following accounts also shew, how doubtful he was, whether the specimens before him were real petrifications, or not.

Tabella 9. Paleas oftendit petrificatas. Prima icon indicat stipitem habitum ex montibus Vicentinis, nomine paleæ petrificatæ. Quandoquidem circa illum montem, lacus conspicitur, cujus aqua res lapideas reddit: Nihilominus non videtur aliqua species paleæ, ob crassitiem; cum nostræ paleæ non tam crassæ appareant. Præterea palea est glabra, et lævis; hic autem caulis est scaber, et inæqualis. Quamobrem, ut nostra fert opinio, hic caulis ad stipitem lapideum vel stelechitem reducendus esse videtur, Quamvis autem stelechites ut plurimum cavus non sit, asserendum erit hoc frustrum stipitis, vel bacilli, hanc cavitatem accidentalem acquisivisse. Aut etiam sieri potuit, ut hic stipes a natura, absque ulla transmutatione, genitus suerit.

side of cd, and parallel to he on the other. B 2. represents the face of a section of the mass, in which ab shews the crystalline matter penetrating into the mass of the same form as in B 1.—B 3. represents the face of the other section, in which he shews the line of crystal mentioned, ha and de lines of crystal running perpendicular to one line of division

Sub numero 2. 3. 4. Paleæ genuinæ petrificatæ designantur: Cum ex magnitudine, cortice, sigura, et soramine tales esse colligendum sit. Hæc enim omnia, has veras suisse paleas demonstrant. Deinde duæ simul copulatæ, et petrificatæ conspiciuntur. Pariter aliæ majores, et aliæ minores apparent. Tandem addamus quod nihil prohibere potest, quin natura absque petrificatione, talia generare potuerit,

Mithologica, ex Aldrovando,

Neque fabulares historiæ ab hoc capite sunt arcendæ, quoniam et ipsæ multa lapidescentia memorant. Itaque serpens ille, apud Homerum, post novem passeres devoratos in lapidem mutatus suisse perhibetur, qui gloriam captæ Trojæ, nullo unquam tempore, perituram esse significabat. Insuper fabulatores Poetæ monimentis etiam mandarunt, intuentes scutum Minervæ essigiatum capite Gorgonis Medusæ, illicò lapideam naturam adipisci i Idcirco Reusnerus quandoque huc respiciens sic canebat.

Dum movet injustum Phineus in Persea bellum, Multaque sert hostis vulnera, multa facit: Gorgone cum sociis visa stupet illicò, tandem Hic lapis immotus sit rigidusque silex.

Amplius poetæ fabulantur Niobem filiam Tantali, fororem Pelopis, et uxorem Amphionis, ingenti dolore, ob interitum filiorum, agitatam, in saxum conversam suisse: quandoquidem ipsi singunt omnes illius filias, et filios sagittis Apollinis, et Dianæ suisse peremptos. Thus much Aldrovandus says of mythology.

Nostri catalogi specimina primum sub distinctione Mythologica ad classes reducta suit, Specimina ligni et lapidis continui titulum habuerunt (HERMAPHRODITUS). Specimina ligni in lapidem prorsus conversi titulum habuerunt (CÆNEUS),

Specimina ligni neutiquam mutati titulum habuerunt (CÆNIS).

Specimina materiæ ligneæ lapideæ et ferrugineæ in eadem continua massa titulum habuere (HEPHAISTO-HERMAPHRODITUS).

Sed quoniam ingenium fabulis non rebus aptum istius-modi nugæ arguunt rejicere placuit.

More regard shall be paid to Aldrovandus his moral reslections, because the scriptures have often alluded to stones, to denote moral hardness or insensibility of divine instructions.

MORALIA.

Moralis doctrina etiam a lapidescentibus documenta percipit. Namque velut plantæ in undis nonnullorum sluviorum mersæ lapidescunt: Ita nonnulli in slumen criminis versantes, omnem humanitatis sensum amittunt, et pectora prorsus saxea induunt, ita ut specie

vision or crack and gf wood with several cracks in it, perpendicular to the direction of the fibres of the wood, in all which there are little thin plates of crystal; this part of the mass is very brittle in all the little crystalline partitions; he is an extraordinary congeries of matter, which to

specie tantum homines videantur. Quamobrem Divus Bernardus hos meditatus dixit, in his cor esse, quod compunctione non scinditur, nec pietate molitur, nec precibus movetur, nec minis cedit, slagellis duratur, sitque ingratum ad beneficia, insidum ad conssilia, sevum ad judicia, inverecundum ad turpia, impavidum ad pericula, et inhumanum ad humana. Quamobrem non possumus, quin hujusmodi cor lapideum indigitemus. Quapropter, in hoc casu, criminosi ad solum Deum omnium aquarum, et lapidum gubernatorem consugere se debent, qui apud Ezechielem, hæc verba protulit. Et dabo eis cor unum, et spiritum novum tribuam in visceribus eorum, et referam cor lapideum de carne eorum, et dabo eis cor carnis ut in præceptis meis ambulent. Etenim hac ratione sceleris limum, æstum somitis, gelu acediæ, salsuginem avaritiæ, ssuchum inconstantiæ, spumam sastus et arenas dissolutionis arcebunt: Quinimo eorum cor, audita voce divina, imposterum non obdurescet.

Musæum Metallicum ALDROVANDI.

Since there is a just foundation for moralizing upon these and all subjects of natural philosophy, it is hoped, the reader will accept of Lord Verulam's sentiments.

Sequitur parabolæ pars infignis. Homines loco gratulationis et gratiarum actionis, ad indignationem et expostulationem versos esse, atque accusationem et Promethei et ignis apud Jovem instituisse; eamque rem Jovi acceptissimam fuisse, adeo ut hominum commoda ob hoc novâ munificentia cumulaverit. Quorsum enim ista criminis ingrati erga authorem suum animi (quod vitium omnia ferè complectitur) approbatio et remuneratio? Res aliò spectare videtur. Hoc enim vult Allegoria; incusationem et naturæ suæ, et artis per homines factam, ex optimo mentis statu proficisci, atque in bonum cedere; contrarium Diis invifum, et infaustum esse. Qui enim naturam humanam vel artes receptas in immensum extollant, et effusisunt in admirationem earum rerum, quas habent et possident, et scientias quas profitentur, aut colunt, perfectas prorsus censeri volunt, illi primo adversus divinam naturam minus reverentes sunt, cujus persectioni sua ferè æquiparant: Deinde iidem erga homines magis sunt infructuosi, cum se ad fastigium rerum jam pervenisse putent, et tanquam perfuncti ulteriora non quærant. Contra qui naturam et artes deferunt, et acculant et quærimoniarum pleni funt, illi verè et magis modestum animi sensum retinent, et perpetuò ad novam industriam, et nova inventa extimulantur. Quo mihi magis mirari libet hominum inscitiam, et malum genium, qui paucorum arrogantiæ fervuli, istam peripateticorum philosophiam, portionem Græcæ sapientiæ, nec eam magnam, in tanta veneratione habent, ut omnem ejus incusationem, non solum inutilem sed suspectam et ferè periculosam reddiderint. Atque magis probandus est, et Empedocles, qui tanquam furens, et Democritus qui magnâ cum verecundiâ, quæruntur, omia abstrusa esse, nihil nos scire, nil cernere, veritatem in profundis puteis immersam, veris falsa miris modis adjuncta atque intorta esse (nam academia nova mo-" dum

70 Metamorphoses LECTURE III.

the eye appears like a hardened clay, but viewed with a glass, evidently shews many small tubes of crystal penetrating the mass in various directions.

This specimen not above two pounds weight, is well worth the attention of a philosopher.

Number CCLXII.

Fig. C in plate 4. p. 55. is no more than the handle of a walking staff of found wood, covered with a hard stony concretion, intermixt with shells, which was found at the at black rock near Dublin; and is inserted

dum prorsus excessit) quam Aristotelis schola sidens et pronunciatrix. Itaque monendi

funt homines, delationem naturæ et artis Diis cordi esse, et novas eleemosynas, et donaria à divinâ benignitate impetrare, et incusationem Promethei licet authoris et magistri, eamque acrem et vehementem magis sanam et utilem, quam gratulationem essusam esse :

Denique opinionem copiæ inter maximas causas inopiæ reponi.

Prometheus, sive status hominis. Verulam.

There are those who think many subjects in natural philosophy exhausted, the design of this quotation, is to shew how weak such opinions are; and is authority for the publication of this book upon petrifications, &c. For the sake of those who do not understand latin, the translation into English is given also.

There follows next a remarkable part of the parable, that men instead of gratulation, and thankfgiving, were angry and expostulated the matter with Prometheus, in so much that they accused both him and his invention unto Jupiter, which was so acceptable unto ' him, that he augmented their former commodities with a new bounty. Seems it not ftrange, that ingratitude towards the author of a benefit (a vice that in a manner contains all other vices) should find such approbation and reward? No, it seems to be otherwife. For the meaning of the allegory is this, that mens outcries upon the defects of nature and art proceed from an excellent disposition of the mind, and turn to their good, whereas the filencing of them is hateful to the Gods, and redounds not fo much to their profit: For they that infinitely extol human nature, or the knowledge they possess, would have them be accounted perfect; they do first of all shew little reverence to the Divine Nature, by equalizing, in a manner, their own defects with God's perfections: Again they are wonderfully injurious to men, who imagining they have attained the highest step of knowledge (resting themselves contented) seek no farther. On the contrary, such as bring nature and art to the barr, with accusations and bills of complaint against them, are indeed of more true and moderate judgments: For they are ever in action, seeking always to find out new inventions. Which makes me much to wonder at the foolish and inconfiderate dispositions of some men, who (making themselves bond slaves to the arrogancy of a few) have the philosophy of the peripatetics (containing only a portion inserted here only to shew the disposition in the sea, to concrete matter and form stone. For there will be more than once occasion to mention that hereafter.

N. B. All wood, when fully saturated with water will sink. For the specific gravity of wood quatenus wood is heavier than water; when therefore its cavities are filled with water instead of air, it sinks. In this manner this wood sinking had a stony concretion formed at the bottom of the sea, and was rolled to the shore afterwards.

Plate 7. fronting Lecture VI. represents several kinds of shells, all petresied except Fig. 1. which is the exact form and size of the pearl muscle shell of Lough Neagh. For some of the rivers slowing into this lake, particularly the river Ban were of old esteemed for the production of pearls; but the price of pearls is so much depreciated of late, by a nice imitation of them by means of the scale of a fish incompassing wax, or some other matter, that little search is made for them. In the same manner hypocrify is depreciating true virtue, in the moral world.

The shells represented in Fig. 3,4,5,6,7, as converted into stone, are in great plenty in the neighbourhood of the lake. Fig. 3. and 5. were struck out of slints; and Fig. 2. shews not only an Echinus parted from the slint, but the bed also in which it lay in the rough mass.

Fig. 4. and 6. were dug out of clay, within one foot of the furface of the earth, where a cart might be loaded in a day's time, by the labour of four men. Fig. 7. is the form of a shell filled with sand, and got in a sand pit, in a very high piece of ground, where a great quantity M might

tulation of his invention: For in a word, the opinion of having enough, is to be ac-

' counted one of the greatest causes of having too little.

of Grecian wisdom, and that but a small one neither) in so great esteem, that they hold it, not only an unprofitable, but a suspicious, and almost heinous thing, to lay any imputation of imperfection upon it. I approve rather of Empedocles his opinion (who like a mad man, and of Democritus his judgment, who with great moderation complained how that all things were involved in a mist) that we knew nothing, that we discerned nothing, that truth was drowned in the depths of obscurity, and that false things were wonderfully joined and intermixt with true (as for the new academy that exceeded all measure,) than of the consident and pronunciative school of Aristotle. Let men therefore be admonished, that by acknowledging the imperfection of nature and art, they are grateful to the Gods, and shall thereby obtain new benefits and greater favours at their bountiful hands, and the accusation of Prometheus their author and master, (though bitter and vehement) will conduce more to their profit, than to be essue in the congra-

might be pickt in the face of a pit dug to the depth of twenty feet. These do not make part of the catalogue of the vendible specimens, because the Inquirer has reason to think they are not uncommon in other countries; For some of these were afterwards found at sifty miles distance from the lake.

N. B. The Inquirer has broken a great quantity of flints, and thereby has enabled himself to make many observations, which he does not think proper to communicate here; because his design is to limit himself as much as he can, to such things as may be deemed new, as he presumes the petrifications are. And although the account of gems and crystals immediately following, be not new to good natural philosophers elsewhere, yet the discovery of them in the shores of Lough Neagh, certainly is new.—And upon that account they are made part of this book.—

Since we are now quitting one part of our design, to wit, the catalogue of the metamorphoses; a quotation shall be laid before you, the reason for which will appear from what shall be said upon it.

Varenius his geography, with the improvements of Newton, Jurin,

Dugdale, Shaw, London, 1734. Chap. 17. Proposition XI.

'There are some waters which petrefy wood or turn it into hard flone.

· A little above the city of Ardmagh in Ireland, there is a small lough, in which if a stick of wood be fixed, and continue for some months,

- · the part that is fast in the mud becomes iron, that in the water turns
- to a whethore, and that above water continues to be wood. This is reported by Giraldus and Maginus: But Briefing by what authority
- is reported by Giraldus and Maginus: But Brietius, by what authority I know not, fays, that it is a fable throughout. In the north of Ulster
- ' (a province in Ireland) there is a fountain, in which if wood be im-

· mersed seven years, it will be petrefied.

· To this there is a note annext,

There is certainly no fuch lough in Ireland; Their famous Lough

Neagh was formerly thought to have a petrefying quality; but upon the examination it is found that the faid quality is to be ascribed

due examination it is found, that the faid quality is to be afcribed

to the foil or the ground adjacent to the lake, rather than the water

of the lake itself (m).

As

As to the quality of the lake, it is part of the business of the fifth lecture to discourse upon it. But whereas the account of the small lough near Ardmagh, just mentioned, may seem to be a misapplication of the old traditionary account of Lough Neagh; the Inquirer thinks proper to inform you, that he does not apprehend that this is the case; for there was once a small lake within two miles of that city, which might have that character. The place where Mr. Maxwel an ingenious minister amongst the Presbyterians lives, is likely to be the place which is meant in this passage. For that Gentleman's house stands on an eminent piece of ground, incompassed with a flat which was all covered with water, when he began to improve it. And upon discharging the water, which was done without much expence (as most flow bogs in Ireland are capable of being drained, to the advantage of the proprietors) and very much to his advantage as a farmer, in which he is extremely skilful and fuccessful, he discovered abundance of materials for the philosopher: And has very often surprized Mr. Hutchinson of Glascow, with phænonema of petrifications, which were deemed well worth the expence of carriage to Glascow. This Gentleman in the first place, built his house with petrifications, on the summit of the island, for such it is called in the Irish language. He raised abundance of marle, whereby he has inricht his land exceedingly, and yet enjoys it upon reasonable terms, from the present generous Lord Primate, who scorns to take advanced profits of a tenant's labour and ingenuity, and whose look upon a thriving tenantry does not fascinate (n), but enliven. This worthy Gentleman is almost able to give ocular proof of the modern generation of Marle, and can not only shew the shells with living fish in them, whose congeries make marl, but could also once shew some of the large shells whose kinds petrefied in that place, make now the walls of his house. He was so kind as to promife once to give an account of these things in writing, but that not being done, this is faid here in order to spirit him up to it. The Inquirer will here also take the liberty to tell, that the worthy Gentleman mentioned, was employed by the University of Glascow about twelve years past, to procure a specimen of wood and stone continuous of Lough Neagh. For notwithstanding his own farm abounded with fuch plenty of petrifications, he never got one of the kind mentioned. He Syringoides, or pipe stone.

Having a large collection of these, with which many other places of the world abound allo, they do not make any part of the catalogue of specimens, which are intended for sale (they, of which these lectures principally treat, being of the rare kind, and peculiar to the lake,) and few are therefore numbered: Some icons are given of them in plate 6. fronting Lecture V. which may be observed there, no more being necessary to be remarked upon them than that figures 1, 2, 3, 4, are all of the fyringoides kind. Fig. 2. has along with the pipes variously contorted, several shells also, and all adhere to an homogene flat Fig. 3. is a pipe stone corroded in such a manner, as to leave hexagonal and pentagonal cells, in fo much that a hafty observer would call it a petrefied honey comb: But whereas the bees are too accurate geometricians, to vary from their mathematical instinct, which directs them to the use of hexagonal cells, and in this specimen, as the observer may count, there are several pentagons. This is therefore not a petrefied honey comb (o).

Fig. 4. is a most beautiful flint with stellate appearances, passing quite through the mass, and also cells of the former kind, pentagonal, and hexagonal, very evident to a close observer, (tho' it seems they were neglected by the etcher) which cells being filled with a very hard matter as right flint is, take a fine polish, and exhibit a beautiful scene to the human eye: N. B. This last specimen belongs to the collection of

the Rev. R. Pococke.

The

⁽⁰⁾ Mr. William Ash-rainey brought a specimen to the Author of this kind, when the work was in the press, found in the County of London-Derry, very near the shore of the lake, by his workmen, when they were turning up clay for brick. The same remarks belonging to this, as to the former specimen, they need not be repeated. The Gentleman mentioned, is intitled to a present of one of these books for this civility.

The lapis fyringoides or pipe stone, is found frequently upon the shores of Lough Neagh, and these stones are in all probability meer petrifications of the complicated roots of some plants. One specimen before you looks like a cluster of worms intangled with one another, (see fig. 2. plate 6. lecture 5.) but compared with that * root gives reason to think it was a parcel of roots similar to that petresied.

Number CCLXIII.

This specimen was found at some distance from the lake, in a bed of clay: What is most observable in it is, that the pretrescent matter has become hard between the roots of the plant, and made a very sirm stone; whereas the root itself became only a loose gritty matter, scarce so compact as that of brick, which may be easily pickt out with the grain of a sless-fork, leaving in the place of it a perforation through the stone. Very large specimens of this kind, have been found with great abundance of holes passing through the body of the stone.

Number CCLXIV.

There is in the custody of Mr. James Simon of this city, and a fellow of the Royal Society, a piece of wood petrefied in the sea, and found in the harbour of Dublin, in the year 1745. Upon breaking this, a sist was found petrefied in it; I say petrefied, complying with the vulgar expression, although nothing remains but the fish bones petrefied, and a glossy appearance like the slimy surface of a fish. This sish penetrated into the crack of the timber, being the rib of a wreckt ship, and the stony matter concreting about it, the cavity is silled with a loose gritty substance, with the form of the fish in it, the esculent part soon vanishing by putrefaction, which is generally quicker than petrification, nothing remained to make an impression but the bones, and perhaps a skin. The rest of the mass is firm stone, which once had been wood, as is indisputable to any one who sees the specimen, having mortices, auger holes, &c.

This opens the way to a folution of all the appearances of fishes in stone, found in many parts of the world, and attributed to the deluge.

Most

^{*} Here the Inquirer shewed a root found in a gravel pit at a great depth, unconverted; Mr. Tull in his husbandry somewhere shews that the roots of St. Foin, penetrate even rocky ground more than four and twenty feet.

Most of which appearances are like this; not but the same gentleman can shew also the body of a fish petresied, which he took out of a lime stone quarry at Rahenny near Dublin; in which the body separated easily from the incompassing mass, and shews several laminæ, to wit, 12 in the length of two inches and an half towards the tail, distinguished by thin striæ of a white sparry matter, the rest being a grey stone. N. B. Cod and whiting boiled break into slakes of the like form; and in this instance putresaction was not quicker than petrisication.

This Gentleman who has these specimens, has made a fine collection, and his ingenuity being equal to his diligence and success in searches,

it is pity he is not better rewarded.

In the same quarry, the same gentleman sound a piece of a bone lodged in clay, which made a stratum between strata of stone, at least twenty seet deep. It is difficult to determine whether this was the bone of a sish, or a land animal: But that it is now a bone there can be no doubt to any one who sees it, and chews it. In a quarry at Harold's Cross near this city, the same Gentleman also sound a bone in a stratum of clay, being a much larger specimen, but equally difficult to be classed with sea or land animal parts.

Number CCLXV.

Is the half of a calculus humanus, taken out of the bladder of a man who died of the disorder in the town of Lurgan. The whole stone weighted very near eight ounces.

Number CCLXVI.

A small calculus humanus, produced in the lungs of a certain Gentleman of the same town, who coughed it up a little before he died. This stone is in the custody of the Gentleman above mentioned; and was given to him by the Author of these lectures *.

GEMS

^{*} There was a curious specimen of petrification of another part of animal substance, found lately in a marle pit within three miles of the lake, it is the jaw of one of the Moose Deer, the horns and bones of which creature are frequently met with in such places in this kingdom: But although the whole skeleton of the creature was found in the same bed, yet no part was petresyed except the teeth, they being plainly turned to stone, as appeared from the experiment of scraping them into a dry gritty powder with a knife. The jaw was extremely hard, and nearly approaching to the nature of stone. A petresied tooth was also found on the sea shore, called the Murragh near Wicklow.

GEMS.

Prime chearer Light!
Of all material beings, first, and best!
Efflux divine! Nature's resplendent robe!
Without whose vesting beauty all were wrapt
In unessential gloom; and thou red SUN,
In whose wide circle worlds of radiance lie
Exhaustless brightness, may I sing of thee!

At thee the RUBY lights his deepning glow,
A bleeding radiance, grateful to the view.
From thee the SAPHIRE, folid æther, takes
His hue cærulean; and, of evening tinct,
The purple streaming AMETHYST is thine.
With thy own smile the yellow TOPAZ burns.
Nor deeper verdure dies the robe of spring,
When first he gives it to the southern gale,
Than the green EMERALD shews. But all combin'd,
Thick through the whitening OPAL play thy beams;
Or slying several from its surface, form
A trembling variance of revolving hues.
As the fire varies in the gazer's hand.

Thomson's Summer.

Had she been true

If Heaven could make me such another world,

Of one intire and perfect CHRYSOLITE,

I'd not have sold her for it. Shakespear's Othello.

Number CCLXVII.

A Pseudo Adamas weighing two pounds two ounces, delineated Plate 6. fronting Lecture 5. Fig. 5. in which the surfaces and angles are represented, but diminished: And whereas there are thirteen surfaces graved, it is most probable that it had only twelve; for the part which seems the root is delineated also; and should not properly be reckoned one, according to the usual manner of crystalline hexagons. For this body

78 Metamorphoses L E C T U R E III.

body, which might by others be called a crystal, is here denominated as above: Because having cut and broken it into several blocks for mechanical uses, which shall be related hereafter, it has a finer lustre and is harder than those brought from abroad, or found in other parts of this kingdom, and therefore deserves an intermediate name between crystal and a diamond.

Number CCLXVIII.

Another Pseudo Adamas weighing half an ounce, of an orbicular shape, and covered with an opaque scurf; as hard as the former and of as fine, or finer a lustre: For the opinion of artists differ.

Number CCLXIX.

A Mocoa weighing one pound, extremely rough and irregular in the furface, so uninviting to the fight in its external appearance, that if the accidental breaking of it in a place where other stones were handled, had not discovered the inward beauty, it would not have been lifted. The beauty of this stone shall be described in the physico-mechanical lecture.

Number CCLXX.

A Carnelian, weighing three quarters of a pound, of an oval form, exactly appearing externally like raw flesh, as Caro the origin of Carnelian denotes; it polishes to great beauty as shall be explained in the physico-mechanical lecture.

Number CCLXXI.

Another Carnelian, being a small fragment of a much greater mass, is only a quarter of a pound weight, of a pure amber colour without any appearance of slesh---The uses of this are told in the physico-mechanical lecture *.

* N. B. The foregoing catalogue is given honestly, tho' not very regularly, (and the crystals and agats shall be described in the physical, and physico-mechanical lecture) In this catalogue, regard was had to a noble precedent the Royal Society, see their history page 115. by the Bishop of Rochester.

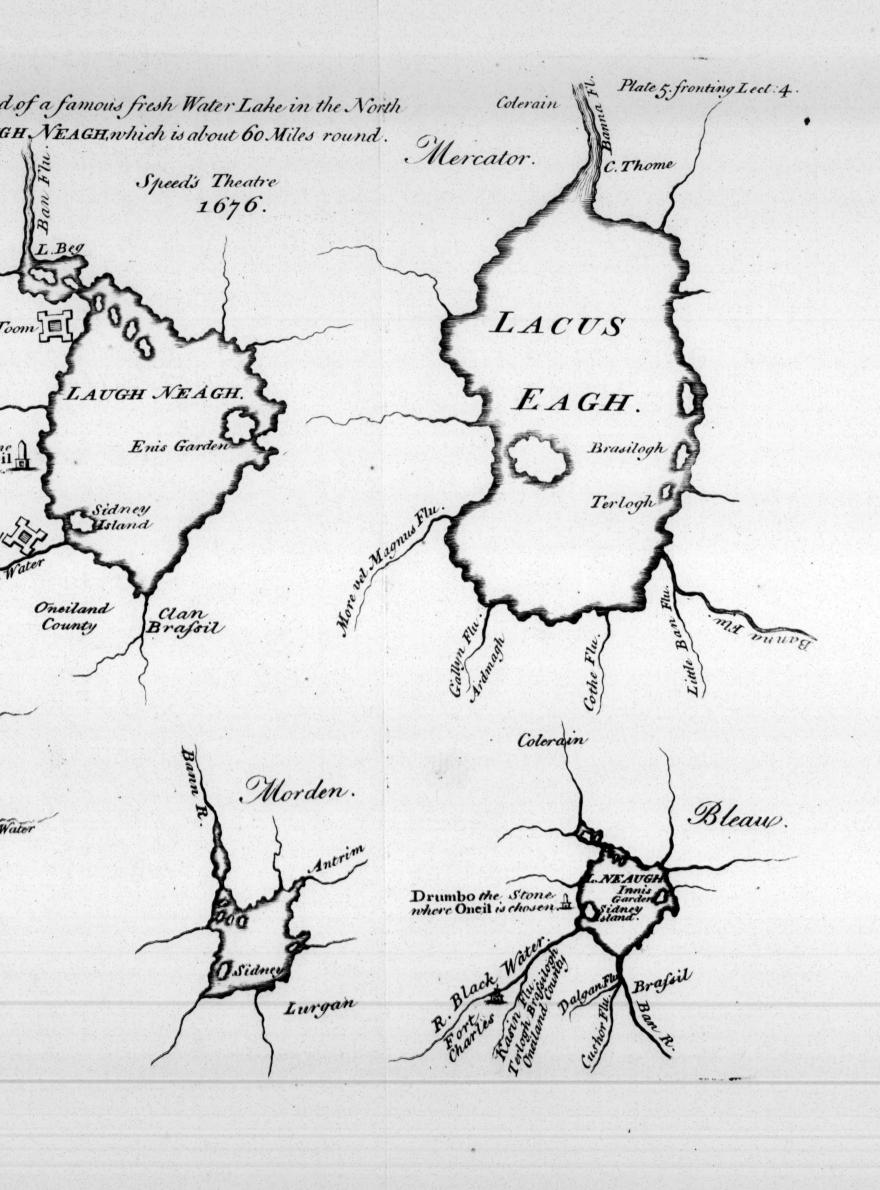
'The Society has reduced its principal observations into one common stock; and laid them up in public registers, to be nakedly transmitted to the next generation of men; and so from them, to their successors. And as their purpose was, to heap a mixt mass of

experiments, without digesting them into any perfect model; so to this end, they confined themselves to no order of subjects; and whatever they have recorded, they have done it not

* as complete schemes of opinions, but as bare unfinish'd histories.









HISTORICAL LECTURE,

ORTHE

HISTORY

OFTHE

Phænomena of Lough Neagh,

With regard to places and strata of matter, whether Lake or River or Springs, Land or Water, deep or superficial.

LECTURE IV.

Ad quæ noscenda iter ingredi, transmittere mare solemus; ea sub oculis posita negligimus: seu quia ita natura comparatum est, ut proximorum incuriosi, longinqua sectemur: Seu quod omnium rerum cupido languescit, quum facilis occasio est; seu quod disferimus, tanquam sæpe visuri quod datur videre, quoties velis cernere. Quacunque de causa, permulta in urbe nostra juxtaque urbem non oculis modo, sed ne auribus quidem novimus: Quæ si tulisset Achia, Ægyptus, Asia, aliave quælibet miraculorum forsan commendatrixque terra, audita persecta lustrataque haberemus; ipse certe nuper quod nec audieram antè, nec videram, audii pariter et vidi &c. Plin. Epist. Gallo suo lib. 8.

Goldsmiths that only give shape and lustre to gold, are far more esteemed, and in a better condition than miners, who find the ore in the bowels of the earth, and with great pains and industry dig it up, and refine it into metal: So those that with great study and toil successfully penetrate into the hidden recesses of nature, and discover latent truths, are usually less regarded, than those who reduce the truths, that others have found out, into systems.

Boyle's Excellency of Theology compared with Philosophy. In hoc gaudeo aliquid dicere ut doceam: Nec me ulla res delectabit, licet eximia sit et salutaris, quam mihi uni sciturus sim. Si cum hac exceptione detur sapientia, ut illam inclusam teneam, nec enunciem, rejiciam. Senec. Ep. 6.

La curiosité n'est que vanité. Le plus souvent on ne veut scavoir que pour en parler. On ne voyageroit pas sur la mer pour ne jamais en rien dire, et pour le seul plaisir de voir, sans esperance de s'en' entretenir jamais avec personne. Pasch. Vanité de l'homme.

ADVERTISEMENT.

HE foregoing lectures were not read, because the Gentlemen were impatient to be made acquainted with the discoveries. The address therefore used upon that occasion, and immediately before the reading of this lecture, is printed also immediately before it. For some readers will rather chuse to pass over the principles, or take them for granted, than be detained by strictness of demonstration from gratifying an eager curiosity. Yet to such, the INQUIRER recommends the previous reading of the lecture of metamorphoses, that being absolutely necessary to Readers, the not so, to Spectators.

ADDRESS.

GENTLEMEN,

THE honour which you are doing to the subjects which are to be treated in your presence, and to the person who has undertaken the task, demands an acknowledgment previous to every thing else.

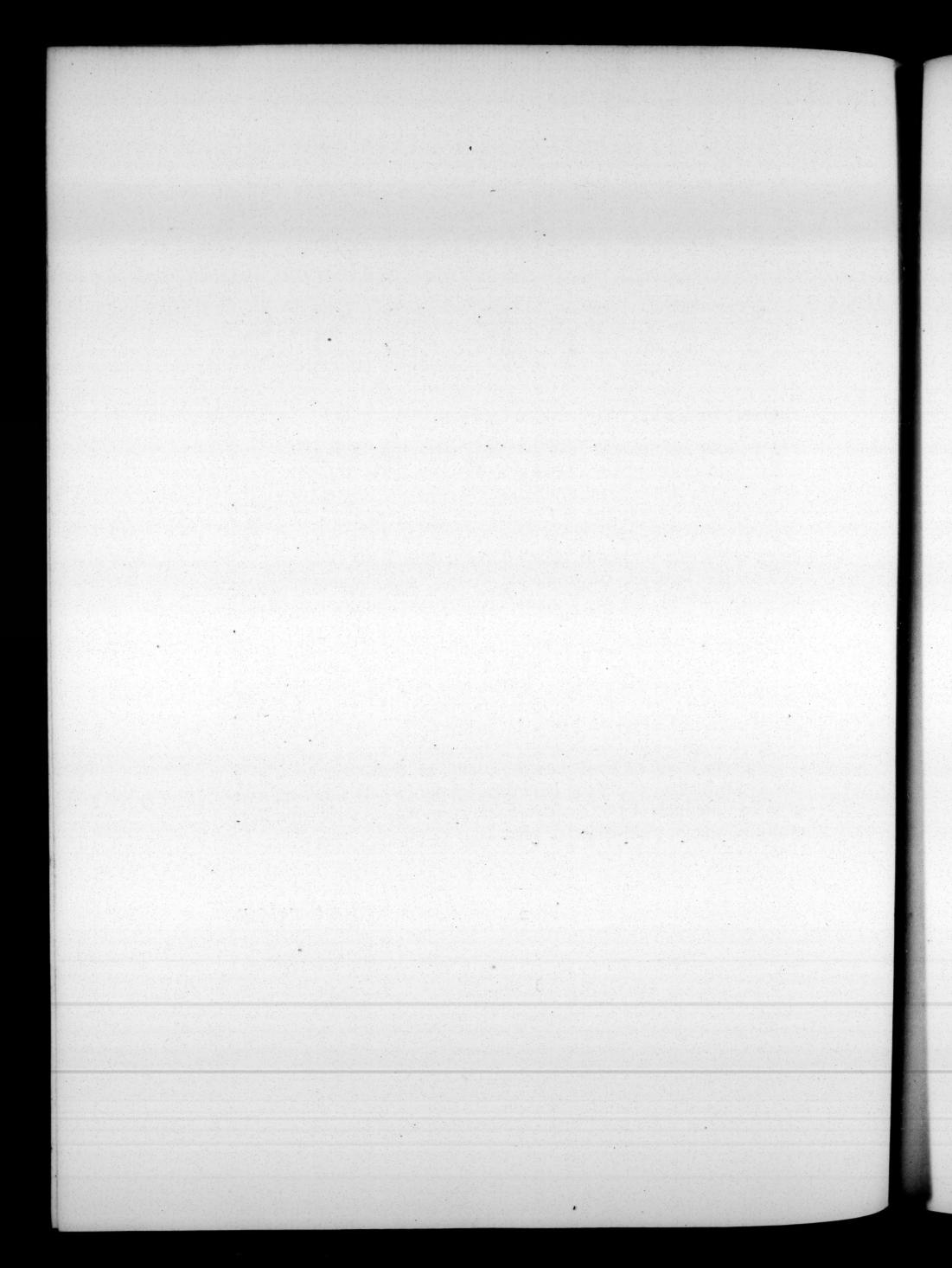
Should this be neglected, a favourable judgment of the performance might justly be forfeited. When knowledge is rated below its value by many, the searchers into it should highly esteem those, who pay regard to their searches. Approbation being a laudable encouragement to human actions, it is never more so, than when it proceeds from the opinion of the discerning sew. That which is commonly called taste, and adorns a character in one point of view, is a facility of right judgment in a particular art. The Painter, Statuary and Poet, are spirited in the execution of their works, by the taste of those, who justly admire their arts: And he who means to examine the material world, for the arcana of nature, is happy in finding those, who may approve his pains, essentially grown languid in the pursuit.

Such you have declared yourselves, and as such, you are highly esteemed by him, to whom you have done honour; whose ambition, after professing his gratitude, is to deserve that approbation, which you have

shewn so prompt a disposition to give.

N 3

LECTURE



LECTURE IV.

THE papers which have been written, and published in the philosophical transactions of the Royal Society upon the subjects now to be treated, are a sufficient proof of the admiration which they have excited in the minds of the curious; and are therefore a proper apology for these Lectures; which should have been spared, if former inquiries had been successful. Since every particle of matter affords a large sund of meditation to the wisest man, such congeries of them, in forms extremely different from the common associations of matter, deserve attention in a singular manner. For such rare phænomena seem providentially to be scattered through the universe, to awaken mankind from that kind of ignorant lethargy, which an unchangeable uniformity is apt to occasion.

We look at the daily sun without any surprize, and the regular returns of darkness with the same unaffecting indifference; but such a day as Joshua saw could rouse mankind to attention, and a short night of

eclipse can awaken the mind to the study of nature.

Was it common for stones to vegetate in form of plants, or for matter to be cast in pillars imitating human art; neither the petrifications of the Irish lake, nor the causeway, (a) which for its stupendous fabric, is thought the work of giants, would have any wonder in them: But they being extremely different from productions in the common course of nature, have drawn many persons from distant parts to view them, have excited some to description, and some to philosophy.

What

⁽a) The Giants Causeway in the County of Antrim, is so well known a phænomenon, that to suppose the reader ignorant of it, would not be a compliment. See p. 2. Math. Lect.

What esteem this present attempt to philosophize after those of ingenious men, who have already tryed, may deserve, must depend upon what shall hereafter be delivered, and your judgment upon it. Nothing shall be said with design to confirm or contradict, any former hypothesis of any other person; nor shall your time be taken up with arguments, to invalidate the opinions of sormer writers upon these matters; meaning that what shall be delivered here, shall at least give the pleasure of novelty without contentious dispute.

All the circumstances of the phænomena, which make the subject of these lectures, and were very lately discovered, shall be fairly laid before you, together with such reasoning upon them, as seem consistent

with true philosophy, that is, with the course of nature.

It may be proper to acquaint you in respect to the petrifications, which shall first be treated of, that all those who have philosophized upon that subject, have reasoned without ever having been able to procure the fight of any one specimen of wood or stone continuous, except one gentleman (d) who having received abundance of specimens and also remarks from the present Inquirer, was enabled to lend presents of the petrifications abroad, to make some experiments upon them at home, and to draw up a short treatise, which makes the last paper upon this subject, in the transactions of the Royal Society; in which paper there is mention made of the present Inquirer, and a sort of promise for the execution of what is now doing (e). It is hoped nothing will be found herein, that will in any degree throw discredit upon that gentleman's performance; he had only an imperfect account of things, and never had an ocular view of the places of production of the petrifications. For most of the phænomena hereafter mentioned, were discovered since the publication of that paper.

There being therefore no account of these phænomena hitherto given to the world, upon real observations of the facts, in many important circumstances, be pleased to accept of the best, which the present Inquirer with great submission to your judgments, attempts to give after much

labour,

⁽d) This gentleman is spoken of in the last lecture as having excellent abilities and inclination for natural inquiries.

⁽e) See Address page 15.

labour, expence and extraordinary fuccess in his searches. This account

will consist of answers to the following QUERIES.

Whether there be any specimen of wood and stone continuous, so clear and distinct, that there can be no room to doubt of the nature of either?

If there be such, what qualities have they?

Where are they found?

To what cause is the production of them to be assigned?

Is that cause peculiar to the water of the lake? What kind of wood admits of petrification? In what time is the petrification effected?

And in what place?

The first question admits of a direct answer, that there are great variety of specimens of wood and stone continuous, so clear and distinct, that there can be no room to doubt of the nature of either: That they are not incrustations, but transmutations, and incorporations of one into the other (e): For you see the table covered with them; and as you have full liberty of handling, and breaking, and cutting, and chewing, and burning them, you have also full information that one part of each mass is a sirm compact weighty stone, the other is a sibrous combustible wood. Of this kind indisputable specimens are laid before you, from 700lb. weight to one ounce.

The

(e) When the fluids of the human body can become bone, and in some cases become stone, and the bones of the human body become soft as wax, as has happened to some persons even in a living state; and can easily be reduced to a gelly in Papins digester, when a petrified crust grows sometimes on the teeth which must be filed off: Who should wonder at the concretions of matter here treated of. For the truth of the sast of the human body turning almost totally into bone; the offssied man in Doctor Barry's custody is a proof: (See a short account of this in the Natural and Civil history of the county of Corke, and something also forward in this lecture; and for the truth of the assertion that the solids of the human body, may become soft and liquiste, the reader is referred to Spond's travels, who gives a memorable account to this purpose.

Notwithstanding all this, the world is not disposed to believe the less surprizing phænomena of wood becoming stone. As may appear from the last book, published in Paris upon the subject of Natural Philosophy, which are come to us with a high reputation.

On parle d'un lac en islande qui pétrifie, le lac Néagh en Irlande a aussi la même propriété mais ces pétrifications produites par l'eau des lacs, ne sont, sans doute autre chose que des incrustations comme celles que sait l'eau d'Arcueil. Histoire Naturelle, &c.

The qualities of these mixt bodies are well worth your notice. The woody part, you see, is extremely hard and brittle, and light, of a brown colour very near resembling that of yew, which is sometimes found under strata of turf, which is usually cut for fire; it admits a plain and takes a good polish; apply a small piece of it to that candle, you fee it blaze and emit a fume; remove it, till the flame be extinguisht, it continues red hot for some time, and falls into very light ashes, having during the operation affected us with a smell, which by many is thought very fragrant and agreeable. This smell is excited by it in some degree, even without burning; and upon breaking of the stones, from which the wood has been leparated, the lame imell will arise but in a fainter degree. It is hoped you will take particular notice of this, because a reference shall be made to it, in the course of what shall be said hereafter. All this kind of wood is not exactly of the same degree of brittleness or toughness; some of it has been found of that degree of toughness, which some kinds of wood have, which are used in human tools. But the application of this to such uses, would not be easy; because the largest portions of it hitherto found, did not exceed those blocks, which are at present before you; which being irregular in their shape, may be best denoted by their weight. One of those blocks which is entirely wood, is 30lb. (d) weight; the other although weighing 50lb. principally upon account of the stony part, may not have so much wood, and the rest have still less. Yet several tons weight of it have been raised, but commonly in such broken lumps and thin flakes, that they are only fit to make fuel for fire: For which ule they are excellent, being in duration equal to pit coal, and in pleasantness of burning preserable; because they excite a fragrant smell. This fuel is almost fit for use the moment it is thrown up from its bed, at most it requires only one dry day to render it fo. The reason of which is, that although it lies in a wet bed, yet it may be observed, that the inner part of the wood is often dry; or appears so, even in that bed; as well as the stony part, which may immediately upon being taken up, be comminuted into a dry powder, as well as split like timber, by means of those hammers, which, you see, are made in the forms of wedges.

This splitting quality of these stones is universal, unless the knottiness of the timber, of which they are formed, occasions sometimes an exception: But the aptitude to cleave is not alike in all; you see two blocks there which were once continuous, weighing 106lb. that took at least forty strokes of a 16lb. sledge before it split; (f) others split with the sourth part of the labour. In that specimen it is worth while to observe, that the wood seems interwoven with the stone, in the very heart of it, lying on the outside in large slakes capable of being chopt with an ax. If an attempt be made to break these stransversly, it will be found extremely difficult, as it would be to cleave wood cross the sibres. It is presumed you will not take amiss the transcribing of a passage from Dr. Hook, relative to the purpose, but never yet applied to it.

Hook, relative to the purpole, but never yet applied to it.

"Having taken, fays he, the best piece of lignum fossile that Doctor

Ent the donor had ever seen, I found it to burn in the open air, al
most like other wood, and instead of a resinous smoak it yielded a

very bituminous one, smelling much of that kind of scent. Cutting a

small piece and charing it in a crucible with sand, I found it infinitely

abound with a smaller fort of pores, only observable in wood, so re
gularly perforating it long ways, and so thick, that breaking it across

I found it like an honey comb. As to the bigger fort of pores also

observable in wood, I could not find that it had any. So that what
ever was the cause of its production, it was not without those small

pores which we have only hitherto found in vegetables; and com
paring them with the pores of charcoal, made with several other

kinds of wood, I find it resembles none of those, so much as fir,

"This wood is got in Italy, in the province of Umbria, now the Untry of Spoletto, in the territory of Todi, anciently called "Tudor; and between the two villages of Collesco and Rosaro, not far from the high way leading to Rome, found there in greater quantity than elsewhere.

This lignum fossile appears, by what the Doctor says afterwards, to be a kind of stone in the seeming form of wood; for he proceeds thus.

"Whatever is by some, who have written of it, particularly by " Francisco Stelluto, who wrote a treatise in Italian, which was printed at Rome in 1637 affirmed, that it is a kind of clay or earth, which in tract of time is turned into wood, I rather suspect the quite con-" trary, that it was at first certain great trees of fir or pine, which by " some earthquake, or other casualty, came to be buried under the earth, " and was there after a long time's residence (according to the several " natures of the incompassing adjacent parts), either rotten or turned in-" to clay, or petrified and turned into a kind of stone; or else had its. " pores filled with certain mineral juices, which being stayed in them, " and in tract of time coagulated, appeared upon cleaving like small " metalline wires; or else from some slames, or scorching forms, that " are the occasion oftentimes, and usually accompany earthquakes, might be blafted and turned into coal; or elle from certain subterraneous " fires, which are affirmed by that author to abound much about those " parts, are by reason of their being incompassed with earth, and so being " close from the dissolving air, char'd and converted into coal (s).

(s) About a year past the Author employed a gentleman, just returned from his travels, and whose acquaintance in Italy was fresh in memory, to write to a curious person there, to send an account of this lignum fossile, and also a specimen; but no answer has been as yet returned.

What Doctor Hook fays elsewhere, may be related here also.

Thus often have been, and are still daily found in other parts of the earth, buried below the present surface thereof, divers sorts of bodies, resembling both in shape, substance and other properties the parts of vegetables, having the perfect rind, or bark, pith, pores, roots, branches, gums and other constituent parts of wood, though in another posture, lying for the most part horizontal, and sometimes inverted, and much differing from that of the like vegetables when growing, and wanting also for the most part, the leaves, smaller roots and branches, the slower and fruit, and like smaller parts, which are common to trees of that kind, of which sort the lignum sossile which is found in divers parts of England, Scotland, Ireland, and divers parts of Italy, Germany, the Low-Countries, and indeed almost in every country in the world. Hook's posthumous works, fol: p. 288.

The wood and petrifications which are part of the subject matter of these Lectures, are not included in Doctor Hook's remark, tho' he mentions Ireland. And p. 297. the same writer says.

One instance I cannot omit, as being the most observable of any I have yet heard of, and that is, Dr. Castle's relation of a certain place at Alpsby in Bedfordshire, where there is a corner of a certain field, that doth perfectly turn wood, and divers other substances in a very.

Thus from the Doctor's manner of accounting for this phænomenon, it appears, that this lignum fossile might, in different ways of considering it, either be called wood or stone: and in this to be similar to several stones found about our Lake, some of which lie before you, and pretty nearly answer this description, and were the usual specimens heretofore produced, and of which it is common to make whet stones.

You fee how easily they cleave in the form of wood, what evident marks and vestigia of wood appear in them: The fragrant smell also upon burning is another circumstance, common to the petrifications of Lough Neagh, and the lignum fossile of Italy. Whether the smells be xactly the same, can not easily be said, without an immediate comparison; but in as much as the Doctor says, the smell of the lignum sossile is not resinous; no more is the smell of these, yet it is a strong smell, when the wood is burning in a large quantity; and a faint smell of the same kind, when only stone is burning; and perhaps this is the scent of bitu-

very short time into stone as hard as slint and agat. A piece of this kind I saw assimmed to have been there buried, which the person that had buried it, had shot small shots of lead into; the whole substance of the wood, bark and pith, together with the leaden shot itself, was persectly turned into a stone, as hard as any agat, and yet retained its persect shape and form; and the lead remained round, and in its place, but much harder than any iron.

To this account may be annext, a passage from Kircher, in his Mundus Subterraneus,

lib. 8. Sect. 2. Cap. 6.

Aquâ sparta 50 milliarium intercapedine Roma dissità vidimus certum quoddam terrægenus, rude admodum, et veluti quibusdam arborum corticibus oppido exasperatum, quibus remotis, in terræ duriusculæ et nescio quo lævore splendoris venam incidimus: Atque

hanc aiebat, esse terram, ex qua Romæ conficerentur pretiosæ tabulæ.

Nullum hic arboris aut rami petrefacti vestigium sed terra prorsus videbatur; quæ intra terram nonnihil mollior, aeri tamen exposita prorsus in ligneam substantiam indurescit; ita ut non secus ac aliud quodlibet lignum facile dolari polirique ebeni ad instar possit——Natitare nesciunt——Flammam non concipiunt——Verbo, neque terra est, neque saxum, neque arbor——itaque olim hasce suisse arbores, videtur cujus signa pervetusti cortices sat superque demonstrant in fodina ubique passim obvii, non tamen succo aliquo lapidisco in petram induratas, sed succo aliquo peracri et mollisicante in minutissimas partes dissolutas, quibus terrestre lutum, cujuscunque id tandem generis suerit intermissum ac intersuum particulas minimas arborum dissolutarum in unam massam terreno-ligneam contraxerit, ita ut nec purum lignum, neque pura terra neque saxeum quid dicit possit.

No other remark shall be made upon this extraordinary account, which Kircher gives, but that the phænomena treated in these Lectures, are extremely different from the matter he describes, which is neither terra, nor saxum, nor arbor. For the specimens of these phænomena, some wood, some stone transformed from wood, some partly wood indisputably, and stone indisputably in different parts of one continued mass, some an intermixture of

the two kinds of matter, as it were, ingeniously woven together.

bitumen (t) which he means. This smell is generally thought pleasant when it is in a small degree.

There are therefore before you two kinds of stone, both of the class.

of petrifications.

I. Those which appear to the eye to be now wood, although they are really stone; and are generally white in colour, porous and comparatively lighter than other stones, cleaving easily lengthways, grinding to a smooth surface, so as to be fit to whet knives, and never yet found with any wood continuous to them, and commonly found in small pieces.

II. Those which are large, harder, and more weighty, black internally and externally, found lately in many instances with much wood upon the surface, and also with a good deal of wood intermixt with the

inward parts of the stone.

(u) See Number CLI. Lect. III.

The properties of both these kinds are. They cleave like wood, they contain abundance of sire, as may be proved by using them as slints, and rubbing one upon another, even when they are wet; and they bear the fire surprizingly: For although they are easily made red hot, yet they neither burn to lime nor vitrify. And it must not be omitted to tell you, that those of the heavy black kind, when burnt in the fire, become white and light, and cleave easily, being made thereby like those of the first kind, and also capable of imbibing a great deal of water; for the internal wood being consumed, leaves many cavities for the water (u).

Besides these two kinds, it may be proper to point out a third species of mixt matter, which is sometimes found in the private chambers of these stones, to wit, shining spangles of a sparry substance, so intermixt with wood, as to appear to the eye through a magnifyer, like beautiful rocks of crystal: And some of this matter collected into clusters of crystals, have such beauty to the naked eye, as to be thought by some to deserve being set in gold. A beautiful specimen of this kind, with a small

⁽t) The Inquirer is not so well acquainted with the properties of bitumen, as to judge accurately in this case, but Boerhave says, Chem. 31 London 1735. Petrolium is expressed from melted bitumen; drops down the rocks, is exceeding thin, very light; of a second similar solution, and perfectly inflammable &c. This liquid is often called bitumen, tho they differ in colour, smell and transparency. The smell therefore of bitumen may be the smell which here is called a fragrant smell; since a bituminous smell is different from the setiment of Petroleum.

small piece of sound wood passing in a straight line through the cluster of crystals, was presented lately to a gentleman in Dublin, who is sedulous in all sorts of inquiries into nature.

Two of the questions being thus fully answered, the next question is,

where are these specimens found?

In order to answer this fully to your satisfaction, it is necessary to lay before you a map of the lake, in which it is not requisite to give the strict dimensions, but only such from common repute, that any suture inquirer may certainly find the places, as any traveller may find a great road through a country, from the honest information of one who went

before him. See Grierson's Map, Plate 5. Lect. 4.

From (a) which is the boundary of the County of Ardmagh, to (b) the mouth of the river Ban, being 21 hours riding, there are variety of shores, fand, stone and bog. From b to c being half an hour * partly stony, partly fandy. From (c) the black water and the boundary of the County of Tir-Oen, to (d) the boundary of the County of London-Derry, being three hours, the shore is fand, stone and bog. From (d) called the river of Balinderry or Coah, to (e) the river Moyola being one hour, the shore is for the most part gravel and iron ore. From (e) the Moyola, to (f) Toom, the boundary of the County of Antrim, and the common discharge of the lake called the lower Ban, being half an hour, is partly fandy, partly a plashy wet shore; from a mixture of fand, clay, and the water of the river Moyola and lake. For here they mix. From Toom to (g) the river Main three hours, half gravel, and half extremely rough, and impossible to be rid close to the water. From (g) to (h) the river of Antrim one hour, partly inclosed in a deer-park, and not examined, partly a very fine strand; from (h) the river of Antrim to (i) Camlin or Crumlin river, two hours, most part good riding, yet many loofe stones are scattered upon the shore, and the banks much worn with water; from (i) to (k) the river of Glenevy, being half an hour, all fand. From (k) to (1) Portmore park two hours, being a rough shore admitting one short space of sand; from (1) to (a) which includes 2 small space of the County Down, which just touches the Lake; together with:

^{*} If the distances denoted by the time of riding, do not seem to agree with the map; its should be remarked that this and every other map of Lough Neagh, are exceedingly inaccurate, and that the Author of these Lectures did mean to give the public an accurate map of the Lake, but could not do it without an encouragement greatly exceeding the present measure of generosity.

with the remainder of the County of Antrim, being two hours, the shore is in some places rough stones, in others bog covered with fand.

The Lake has two islands with stone buildings in them: For the small Lake, called Lough Beg, north of Toom, as commonly reckoned part of Lough Neagh, is not in the survey. That Lough has an island in it, and the ruins of a church; that island was once part of the main land. One of the islands of the great lake is a league from the shore, the other, one third part of a league, and are evident proofs of the incroachments of this lake upon the main land: For these houses were certainly built when the grounds they stand upon, were contiguous to the main land.

This great body of water covering about an hundred thousand acres, and formed by the influx of eight rivers besides small rivulets, may be determined to be of modern date; by modern being meant, any time later than the general formation of seas and lakes, when this globe underwent a considerable alteration at the general deluge. For it is perhaps the shallowest lake in the world, of its dimensions, being according to the account of navigators upon it, not more than eleven fathom in the deepest place. Whereas the lake of Geneva has been tried with four hundred fathom of line, without proof of the bottom being reacht: Surely in a course of some thousand years, sloods might have worked deeper than eleven fathom, which does not exceed the height of an ordinary church steeple.

Besides the evident proofs of its incroachments just mentioned: (d) The discharge at Toom being very liable to be choaked with sand is

always

(d) In a pamphlet published in the year 1738, concerning the lowering the water of this lough, there is the following remark which is to the present purpose.

I have not mentioned the rapid river Claude near Portglenone, because it falls not immediately into the lough itself, but enters the lower Ban near Portglenone, and there being obstructed in its course towards the sea, by the very deep water near Portna, it is driven backward in time of floods. Besides as the course of the lower Ban runs towards the north, and the north wind that blows against them is often strong, and in the time of poor Richard the second, when he was in Ireland was so long northerly, that he had not a post from England in six weeks after that the Duke of Lancaster was landed, and his subjects in arms against him, this northerly course of the wind blows the water backward in so strong a current that if any one throws either a stick or any light thing upon the water, they will see it swim upwards against the course of the river, till it be out of sight. I will ask now what becomes of this vast quantity of water which comes into the lough and is staid there, and perhaps

always occasioning a delay in the flux of its water, which raises and extends its surface. And the violence of the waves tears and rends the banks, whether of turf or clay: But the former of these seems to have been the kind of matter which at first made the common basin of all the rivers. For there are very good reasons to incline any one to think, who considers it attentively, that the great bogs in the County of Tir-Oen marked (q), and those of the County of Ardmagh marked (x), and that of the County of Antrim marked (x), were all once one continued bog, with some islands of firm land, and perhaps small stagnant interspersed lakes. For of this kind the great bog (x) is at present; having raised tracts of arable land in it called islands (x) containing thirty, forty, sifty, and sixty acres, and small lakes of one acre of water and more, to the size of one which is four miles round, called Lough Gullian.

Seeing that it is generally and not unreasonably supposed, that all bogs of turf have springs under them *, it should seem likely, that this lake should abound with springs: But on the shores and neighbouring Lands, although diligent inquiry was made concerning them, very sew were found, and hardly any that kept their sluid state during the hard frost, in the year 1740, except one small spring marked (x), and another of chalybeate water, marked (y). There is a remarkable well marked (z), called cransield, and mentioned in the Philosophic Transactions under the name of Cranbourn, with a superstitious account of brown crystals, growing there in a night's time, and that only on

perhaps never runs out. Without answering matters of fact with philosophical conjectures, it hath made the lough itself rise and spread, and fill itself with sand-banks, till it hath spoiled its own navigation, and not only incompassed one church, that of Ballyscullin, and drowned a great part of the parish, but has covered great tracts of other rich land, that once adorned it with those noble oaks and firs that we now fish out of it.

One fisherman that had removed his house twice, and was forced to move it again, complained, that he knew not where he might set it, for the Ban followed him. See an answer Lect 6.

† They are called Derry with some additional word in composition. Derry in Irish perhaps from does an oak, signifying a planted piece of ground incompassed with a bog. Innis in Irish signifies a piece of ground incompassed with water. London-Derry, Innis-skillen.

* Although the top of a mountain called the DEVIL'S BIT, in the County of Tipperary, be a folid rock to a confiderable depth of pebbles cemented, yet it has a tegument of excellent turf about two feet thick, without any appearance of possibility, of being produced by springs, but with a fair probability of being produced by the roots of heath constantly growing there.

May eve: Large specimens of these crystals much resembling brown sugar candied lie before you; they were found two miles from the spring, growing plentifully in the clests of a rotten rock, and also in the sod which grew over it, from which it seemeth probable their growth was pretty quick: For the sod appeared to be a late collection of dirt and grass. Diligent inquiry was also made concerning springs under the water of the lake; one person of no great veracity, asserted, there were places unfrozen in the winter 1739-40.

These crystals Mr. Boyle takes notice of in his treatise of Gems; where he says, there is a lake in the north of Ireland, which supports

- fish as well as other lakes, when nevertheless in the bottom of it are rocks, to which adhere masses of beautiful figured substances in clear-
- ness and transparency imitating crystal; a present of which the chief proprietor of the lake had sent him with a promise of more.

Concerning these crystals, more shall be said hereafter.

But it is time now to answer the questions concerning the places

where the specimens of petrification have been found.

Having given a description of the lake, together with the distances computed according the common rates of travelling, be pleafed to cast your eyes upon that point which lies on the fouth eastern fide, under the title of Ardmore point, close upon the great bay called Tradubach: There was the first specimen found of indisputable petrification, weighing about twenty eight pound, partly exposed to the air, and partly in clay, within ten yards of the water of the lake, and which had been a short time before covered therewith. Its situation was such as to render it easy to suppose that it had been rolled thither by the winter storms. For large masses of other matter heavier than water, are frequently seen upon shores of the lake to which they did not belong, their native beds being some miles distant, particularly lumps of turf bog, some ton weight. For water deducting from all bodies that lie in it, and are specifically heavier than a weight equal to that of as much water, as the furface of the body could contain, (that is, by ballancing so much of the weight it is equal to a deduction of so much, so long as the bodies continues in the water) the overplus weight by which the body finks, is but a small resistance to the violence of waves, which may roll them hither and thither. The

The shore of Ardmore point is rough, abounding with round stones, which render it unpleasant, but not impossible to be rid. 'Tis nearly of the same kind for two miles northward; but as far to the south is altogether a bed of turf or pete, covered unequally with the fand of the lake, where the water having eafily washed away, the soft yielding substance of the turf throws up a deceivable covering of fand.

Although diligent fearch was made along this shore for specimens, and many little fragments were found, yet none with wood continuous, except this one, till two years afterwards; when three large stones of the fame kind, were found in the water near the fituation of the first *.

Whereas former Inquirers have left upon record, that the mouth of the black water and neighbouring shores, were particularly remarkable for productions of these petrifications, it was proper to examine those places accurately; which was done, yet nothing curious found. And to come directly to the purpose, the entire encompassing shore of the lake was carefully fearched without fuccess, from the former point, to a point called Ahaness, in the County of Antrim.

This place feeming to be the forge, where these materials receive part of their form, deserves a particular and accurate description: Because future reasoning concerning these productions, must in a great measure

depend upon it.

Ahaness is half a mile south of the mouth of the river Glenevy, and the shore between them is fandy, it is three miles north of Portmore park,

* The letter of a very worthy Clergyman, who employs his time usefully in religion and and husbandry, is to this purpose; who at the request of the Inquirer, dug a pit in a part of the shore which was not examined accurately before.

October 9, 1749. A pit was digged five yards from the water of Lough Neagh on Tradubach bay, in the parith of Sego, and County of Ardmagh, nineteen feet long, nine feet broad, and nine feet deep.

At 11 inches from the surface, a piece of petrified wood was found in red crumbly clay, some small pieces of black wood, some common stones, some lime stones.

At 22 inches from the surface, more black wood than before, clay, part red, part

black, crumbly and hard to dig.

At 33 inches, a greater quantity of black wood, and larger than before, black mouldy clay. Erom 3 feet down to 8 feet, a few small pieces of black wood, very few common Itones, black clay as before, at the depth of 8 feet from the surface, the largest piece of wood was found; 9th foor, the same fort of black clay, quite dry, not the least appearance of water throughout. J. CARROL. Compare this last remark with page 98.

park, markt (1) †, and the shore between them is for the most part rough, except in one place for five hundred paces it is sandy and pretty deep: The part immediately adjoining upon Ahaness, is a surface of yellow clay covered roughly with stones. The bank over the shore from Portmore to Glenevy river is high, from seven to twelve seet in different places, and is a stiff red clay; the appearance of it being perpendicular in some places, without any plants growing upon it, denotes the violence of the water of the lake in winter sloods and storms; which have washed away all the surface of the earth, between it and Ram's island (0), which lies about one league from the shore; but was certainly once part of the main land.

At Ahaness there has been raised from time to time, above two ton weight of stones, with wood continuous to them, one of which weighing 150lb. is deposited in Trinity College, near Dublin (p); and several small fragments of extraordinary rarity, got by breaking the large stones, are deposited in the University of Cambridge, with the Woodwardian professor of the knowledge of sossils (q). A collection of the same kind and value, is also presented to the learned Dr. Richard Mead, and may be seen among his rich and judicious collection of rarities: The receipt of these was acknowledged in a very handsom manner, by

letters from the Uuniversity and Doctor Mead (r).
These specimens, with what lie before you, shall be vouchers, not only

for the fact of petrification, but also for a good deal of that reasoning, which shall hereafter be used; in order to make which as conclusive as possible, every circumstance of the place, wherein these heterogene

wood-stones are found, must be minutely related.

The bank at Ahaness is twelve feet high, between the bottom of which, and the lowest water mark in summer, there is a space of about ninety feet, which space in winter is sometimes covered with water. Upon digging a pit in this place (of which there are several made)

† Grierson's map. (0) Otherwise called Innis Garden.

(9) See the letter from the University of Cambridge, in the address prefixt to this

ook.

⁽p) This specimen and petrification first found, were presented to the University near Dublin, the first found specimen was fixt in a frame of holly: There was also presented at the same time, a very curious small specimen, which the Rev. R. Disney, T. D. in the receipt which he gave for the whole as Librarian (there being some books also presented at the same time) promised to have framed and glazed for preservation.

⁽r) See letter from the University and Doctor Richard Mead, in the Address.

The upper stratum of matter is red clay, three feet deep, the second stratum is stiff blue clay, four feet deep, the third stratum is a black wood, lying in flakes four feet deep; the next stratum is clay. From the top of the stratum of wood to the surface of the earth is seven feet, and before the water of the lake increached fo far upon the land, it was nineteen feet, which is necessary to be remarked, in order to account for the form in which this wood lies. For it has no intermixture of the neighbouring strata with it, nor has it any void spaces as should be found amongst timber thrown in a heap, unless some incumbent weight should fo press the mass, as to reduce the round form of trees to a flat, and thereby fit them so exactly together, that they may appear one solid uniform mass; or so press the small boughs with their leaves into the interstices, as to give the appearance of one solid homogene mass. In many places of this mass, the leaves of trees seem principally to be pressed together, so as to form matter of the visible appearance of what the workers in leather call Jump, being thin parings so united by pressure, as to become sufficiently firm for heels of shoes.

For the wonderful effects of constant pressure (the' the pressure be

not great) shall be demonstrated in the next lecture.

Such a kind of appearance this stratum of wood has; it is one uniform mais capable of being cut any way with a spade *, tho' more easily with the grain, and breaking thereby into small flakes, may be thrown up to be fuel for fire: It has evident marks of violent collision or pressure, as may be seen in the specimen before you; where the sibres of some are squeezed up into a complicated cluster, as if a man should squeeze end ways in a vice, a short piece of hempen rope; or laying a longer piece upon two planes almost contiguous, should by a pressure from above, suddenly bend the fibres and force them out of their usual direction, a little way into the aperture below, and perhaps tear some of the fibres; (e) which remark will appear to be of fingular use hereafter. The flaky parts, upon close examination, seem to contain in them small boughs, and are themselves principally made up of leaves very closely prest together. Sometimes this wood will not easily break, and in that case, requires the aid of some other tool to separate it from the mass, which, if carefully done, may afford a block of two, three or four hun-

⁽e) See Number XXVII. Lect. III. Fossil wood is often soft in the earth, and grows hard and tough in the air.

dred pound; which when examined, are found to confift more or less of stone: One of them at present in your view, is about two hundred

and fifty pound weight.

Here and there is found small congeries of white clammy matter, much of the appearance and consistence of thick cream, or liquid and grumous chalk, not gritty, tastless and easily dissolving in the mouth after chewing; perhaps it may not be improper to call it lac-luna. For when it is dried, it becomes a white substance, with a small degree of

cohesion, like very brittle chalk.

It is not easy to examine the wood in these pits, so as to judge of the groffness of the timber which makes this stratum: Because they are fo compressed together, that no distinction can be made. The appearance should at first incline one to think, that they were an heap of chips with a few blocks of gross wood thrown in amongst them. The influx of water at the time of working, is another difficulty in this inquiry. Nor is it easy to determine whether this water be a real fpring, or the water of the lake which is some feet higher than this stratum, and not many feet from it. For although the stratum of clay immediately above the wood, is feemingly tough enough to refift all penetration of water (as the working peafants well know, who press it with their feet into holes, when the water flows upon them in a stream, and thereby stop it for some time,) yet if this bed of clay has any open passage any where in the neighbouring lake, the water may easily flow in, and afterwards infinuate itself through the layers of wood: For although the inner part of a large hard log feems immediately dry, when taken out of its bed, yet the surface is always wet. It is probable that this water is no other than the water of the lake; because, were it that of a fpring, perhaps somewhere on the shore in the neighbourhood, it would burst out and shew itself, but no fountain is observed to be in the neighbourhood.

It must not be concealed that this stratum of wood, does not seem to keep an exact parallelism with the horizon, but towards the land seems to rise higher, in so much that at the bottom of the bank, at an height to which the water of the lake never reached, this ligneous stratum was observed, and in it a petrification of some pound weight, which should have been taken, if there was not danger of bringing down twelve seet

height of clay upon the workman's head.

The

The qualities of this wood as to burning, cleaving, and bituminous smell, have been already taken notice of, and need not be repeated (f). And as to the extent of this stratum of wood, you may as well judge of it from the map as from the land: For it is certain, that it is continued under the clay bank into the land, and under the water of the lake the contrary way; how far it extends along the shore, may be tried by others, to whom the expence of digging will not be burdenfom: Experiments hitherto made, do not take in more than a hundred feet. But that it extends under the lake a confiderable distance, or that there are strata of the same kind of matter, a considerable distance from this place, under the water of the lake is plain, from the finding of specimens at twelve miles distance from it. For the promontories, which project out into the lake, called by the neighbouring inhabitants points, would in all probablity interrupt the rolling motion of any stones from Ahaness pit, to places on the same side of the lake. Therefore the specimen found first at Ardmore point, was the property of some other pit, which perhaps lies out in the body of the lake; and the finding of three large fpecimens afterwards, in the water near that place, is a good proof of this. For the Rev. Mr. CARROL, a very worthy Clergyman mentioned*, who lives near Ardmore point, and has a curious disposition to search into nature's works, confiftently with his clerical employment, which he has for many years attended with diligence; not only found some specimens, in water, of petrifications with wood continuous, having fearched at the request of the Inquirer, along Tradubach bay; but also digging to the depth of nine feet, gave an account by letter, of his having met with some lumps of mixt matter of the same kind; but he did not arrive at any continued stratum of it in the manner described at Ahaness; perhaps he did not go deep enough, or perhaps the stratum lies under the water, where it is not easy to get information. That a stratum lies fomewhere in the neighbourhood is probable. For one specimen he found in the water, was two hundred weight; and being flat, could not have been rolled far. For if it had, the action of rolling would have altered its shape, at least have worn off the wood: But it had a great deal of wood in the furface.

It is still of more importance in determining this to observe, that the stratum of wood at Ahaness lies seven feet below the water, and could not have any part of it rolled into the lake, till the seven feet of clay was first washed away, but that still remains as a barrier between it and the violence of the water. There are therefore strata of this matter in the body of the lake, made bare of all superincumbent strata of dense matter, and therefore liable to be disturbed in storms. Even at Ahaness if a fair experiment was made at a distance from the shore: Where the water is more than seven feet deep. There is little doubt but that many specimens might be found. But to proceed in describing other places,

where specimens have been found.

Observe Gentlemen in the map the river Camlin, about two miles distant from Ahancis: Upon this river about one mile from its mouth, was found the largest specimen of these petrifications: It weighs 692lb. and being too weighty for a table and unmanageable, it is placed at the outside of the house (g). If the fragments broken from it, of which here is one, be added, its weight was more than 700lb. It is intirely stone without, and this fragment of it shews that it has a great deal of wood within. It was found under a bank fix feet high, and almost buried in gravel raised three foot above the surface of the river, when the water was low: It appears like an old stump of a tree, and was found in the posture of growth: Care was taken in raising it to observe nicely the bed in which it lay; but nothing fingular could be feen: It had no roots extended from it, nor the appearance of any in the gravel decayed or petrified. This was not the place of its formation (h); It feems to have been rolled thither by some violent flood from an higher part, of which violence the banks in many places give evident proofs: And the lake is no way concerned in the production of this specimen of petrification, for it could not move against the natural course of the water. There is therefore some bed of petrification higher up in the river Camlin. Search

(g) See Plate 3. fronting Lect. III. And description, Number I. Lect. III. Also advertisement Lect. III.

⁽h) This specimen is very extraordinary, and perhaps the most curious of any in the world, one equal to which may perhaps never be found, even at the Lake which is so famous for them; and of which, a gentleman of letters, wealth and extensive acquaintance in the world, said, he knew places where it would be purchased at a hundred guineas. It

was also made for some large stones of this kind, upon the river Glenevy, but the fands having covered the places where reports fay they lay, no discovery was made, and therefore all remarks may be spared. Belides

is at present kept in a large oaken frame, whereby it may be conveyed to any place without injury, and that foreigners unacquainted with the English language, might be acquainted with it, a short description of it was printed in the following form, and sent abroad with a copper plate of it annext thereto.

In gratiam extraneorum,

SPECIMEN LIBRI

Qui inscribitur

LECTIONES

In Philosophia Naturali, quibus fundari poterit Ratiocinium, quod respiciet Petrificationes, Gemmas, Crystallos, et Qualitatem Sanativam Lacus N E A C H I in Hibernia.

Propositi Fautores fiant.

Divitibus et Doctis, qui volunt et qui polqui Linguam anglicanam parum, aut neutiquam callent, Descriptio molis Saxo-ligneæ, Ære, et Verbis, aliquo modo exhibetur. Præ Multis, quorum continebit Syllabum in lucem jam proditurus Liber, profertur inligne illud Saxo-ligneum Specimen; ut pote quod apud posteros duraturum stabilibit veritatem, aliis forsan, minoris pretii et ponderis, amissis aut perditis; adeo imitatur aurum, cujus pondus est valor.

ΛΑ ΑΣ 'ANAIΔΗ'Σ, potiusve MOLES SAXO-LIGNEA ad profunditatem quorundam digitorum infigniter lapidescit, ig-

* Nevil, LLhuyd, Smith, Molyneux &c. vide acta Eru ditorum Angliæ Philosophica. Titulo Regalis Societatis.

Uandoquidem multa INQUIRENTI nisq; plus quam Scintillas chalybe percussa, forte fortuna occurrebant, quæ antehae quem valde conterit, emittens, lignum intus frustra quæsiverant alii, iique rerum * nova- | reconditum mollius quam pro more ligni harum avidi: SPECIMEN operis delineatur, bet. Fragmentum enim C. D. (duæ enim ut ii, quibus cordi sunt istius modi studia, sunt facies ejusdem fragminis secundum modulum digitorum exaratæ) ex apice Molis, magna non fine vi diffissum, ex ligno, linea lent, opus est Philosopho in arcana Naturæ' b c. æque ac lapide alibi constans, argumenimpense inquirenti; quorum gratia, præcipue tum est, lignum intus in corde Molis latere; cujus copiam, rimando vulnus a cultello, primi spectatum admissi acquirebant. ÆS signatum A (una facies Molis Saxo-ligneæ, cujus altera B) exprimit pondus, testimonio magistratûs, cujus erat in Emporio pendere res mercales. Color eft albus aliquantulum flavescens, quoniam forsan in Sabulo, quo reperta est, diu jacuisset; cujus adhuc cernuntur calculi, per scabram superficiei partem, cellulis, velut malleo fixi. Materia vero ita colorata crassitie hodiernum non excedit monetæ argenteæ Anglicanæ Denarium, reliqua. nigrescit, præter quod quibusdam est cærulea locis. Atque ita se habet in aliis. Plurima enim petrificationis Specimina in superficie

Besides these places, there are others too numerous to be mentioned particularly, wherein petrifications are found, that is, those of the white light kind, which never were feen with any wood continuous. It is common to find them upon the shores, such as are all stone and of the white kind, and the general remark upon them is, that they have the marks of an ax upon them. But this last circumstance is a good argument to prove, that they are no more than the heavy black stones carried from their native beds, and bleached by the fun, after being well wathed with water, fo as to lofe all their wood. For the wood of Ahaness pit, is frequently observed to break cross the fibres in so smooth a manner, fometimes floping, fometimes transversly, as not improperly to represent the effect of edge tools.

The wood when petrefied, has often a furface fimilar to these smooth transverse sections, but it is probable the wood was first broken into this form and petrefied after; because it is not easy to break the stone

cross the fibres, into these smooth surfaces.

Thefe

terræ jacentia albo gaudent colore, a creta nuntur, radix scilicet subter terram, pars adnon multum abludente, pauca vero cæruleo, prælertim si aspergantur pluvià: intùs nigres- erant vestigia radicum sese undique extendencunt: Si conterantur Specimina, pulvis fiunt tium, pro more aliarum arborum, neque ulla fuscus, aliquando subalbidus, et inter conteren- indicia molem hanc, dum arbor fuit, ibi vità dum, odorem excitant sensationi grate balsami- frui vegetabili. Nam proxima fluit aqua jucum, et sibimet ipsis forsan peculiarem.

Inventa est hæc Moles Saxo-Lignea, duo millia passuum a Lacu, juxta sluvium Camlin, supra vero aquæ superficiem in ripa tres circiter pedes: Supra hanc materia perpendicularis sabulosa, tanquam Ripa supra Ripam, vel LE M insignem Saxo-ligneam? Cuinam deagger quidem videtur; attamen est stratum materiæ antiquum, minimeque factitium, gramine, præter faciem sex pedum versus sluvium, haud tenuiter vestitum. Facies Ripæ quasi nuper aeri oculoque exposita, nullà gaudet herbarum specie. Circa molem vero Saxo-ligneam, cujus pars aliqua prominebat in Ripà inferiori vestimentum erat tenue gramineum.

MOLES hæc, neque truncus neque radix arboris, utriulque vero particeps, vegetationis habuit posituram; prout marcidæ arborum partes locis præsertim cespititiis sæpissimè cer- 120, dicere exoptat.

modum scabra trunci in aere. Nulla autem gis, atque, etiamfi juxta crescunt frutices in Ripâ sabulosâ, Arbor, magnitudinis, qualis hæc olim fuit, in materia instabili se neutiquam stabilire potuit.

Unde igitur, et quæ vis huc appulit MObetur causæ immediatæ metamorphosis illa miranda? Quantum eâ peragendâ insumptum temporis? Qualis fuit arbor, quantum tempus, quænam causa, ubi lectus genialis? Omnium est quærere non omnium dicere.

Quid de hisce aliisque multis (quippe 400 funt Specimina*) fentit INV ENTOR, libro Phænomena Lacûs historice & philosophice exhibente, forsan non sine veritatis filo, animum, per effectuum labyrinthum, ad CAU-SAM UNAM PRIMAM caute ducente, LECTORI, PERITO, CANDIDO, BENEVO-

Horum catalogus forsan postbac in publicum prodibit.

These white stones also upon breaking, sometimes exhibit a more black compact stone in the heart, being not yet perhaps sufficiently or thoroughly scorcht by the sun. A culinary fire will in a short time reduce these black stones, to the state of those sound upon the shore, that

is, whiter, lighter and more fiffile.

In many parts about the lake, there are fields wherein the plough and the spade frequently turn them up, and they never are further regarded, than when one of them seems by its shape, sit to be used in sharpening of instruments, the peasant commonly stoops for it. And of this kind petrifications are found in gravel, even eight miles distant from the lake (i).

The history of the healing quality of the lake, shall now be related. Mr. Nevil in his observations on Lough Neagh, describes fishing bay, (markt (r) in Grierson's map, (fronting Lect. IV.) which has been most remarkable for cures in the following manner. This bay is about half a mile broad, has a fine sandy bottom without a pebble in it; so that one may walk in it with safety and ease, from the depth of the ankle to the chin, upon an easy declivity, at least three hundred yards before you come to that depth'.

The history concerning this bay, may be found in the Natural and

Civil History of the County of Down, pages 159 and 160.

'The occasion of first taking notice of this bay for cure, is said to have been in the reign of Charles II. in the instance of the son of one Mr. Cunningham, who had an evil to that degree, that it ran on him in eight or ten places. He was touched by the king (to whose royal touch, a virtue was at that time ascribed of healing this distemper) and all imaginable means were unsuccessfully used for his recovery: his body was so weak that he could not walk: But at length he was bathed in this lough for eight days, his sores were dried up, and he grew healthy, married, begot children, and lived several years after; Many frequented the lake, who were afflicted with running sores, and returned home perfectly healed. These instances are so well attested.

⁽i) Having thus finished the history of petrifications, it may be proper to declare, that whereas in the advertisement to Lect. 3. it is said the collection consists of above a hundred articles more than the printed catalogue contains, now having determined the number of articles, necessary to be given in print, the reader may be informed, that the collection consists of above three hundred articles more than are printed; and which are well worth observation.

tested, that they admit of no dispute, yet we can scarce be persuaded,

but that this lake was much more early remarked for the healing property aforesaid, than the period here assigned; though it might in a

long tract of time have gone into disuse, and be neglected and for-

gotten: The very name of it seems to hint at this quality; Neasg and

· Neas in Irish signifying an ulcer or sore, how easy is Neasg corrupted

· into Neagh.

The chymical analysis of the water discovers nothing in it peculiar or different from the contents of other loughs or waters of other bays in this kingdom, all of them exhibiting very nearly the same fort of residuum,

as particularly appeared by experiments made in concert on the waters

of this lough, and the famed Lough-Leighs, or the healing lough, in the County of Cavan, each yielding upon evaporation a small quantity

of bituminous, or at least sulphureous matter, from which they both

feem to derive their healing quality before hinted. For it is obfervable, that the folid contents of these waters, differ greatly from

those of most common springs, which generally contain a dissolved na-

' tive lime-stone, which the waters of these loughs do not; but a dark brown viscid matter, sparkling, stinking, and burning black on a red hot

' iron; and herein they differ greatly from the petrefying waters of this

kingdom and Great Britain, which abound with lime-stone, and whose

• petrifications are a true native lime-stone.

It is very probable the water of this lake had a great fame for a fanative quality, before the experiment was tried on Mr. Cunningham: Otherwise what should induce him to an experiment of this kind. Are not Abana and Pharphar, rivers of Damascus, better than all the waters of Israel, is a sentiment natural enough to those who only mean to use natural means. If this gentleman was of England, he would probably have thought it more prudent to have used any pool in his own neighbourhood, than to go to another kingdom, and to a part of it that was then very ill cultivated †: If he was of Ireland, what occasion had he to go to the king, when he had the better means nearer at hand *. Take the story in any light, and it sufficiently proves the reputation these waters bore, even so early as the reign of King Charles the second. Such reports always arise from unsought occasions, rather than defigned

† If the fame of the lake was not very extraordinary.

^{*} Perhaps the opinion of the royal touch was then most credited, and that failing, the other was tried.

figned inquiries. The curing of mangy dogs in the County of Cavant, gave rife to the fame of the lake there, the virtues of which were often tried afterwards on human bodies. The first occasion of the fame of Lough Neagh in this respect, records do not relate: Perhaps, if they did, it would be as idle as the story of the origin of the lake, which has too many circumstances of an old woman, and a pitcher, and a well, and a door, and a sudden overflowing of that well, so as to form a lake because the door was left open, to be related in a serious book. The purpose here is to shew, that the waters of Lough Neagh have had a reputation of healing diforders of bathers for many years past; and that it still continues to have this reputation, the numbers of people who go from Dublin and other places to Fishing-bay, and to Lurgan, in order to bath in the lake during the summer season, are sufficient to testify. The physical cause of this quality in the lake, and that of petrefying, if it has both or either, shall be inquired into and assigned in the following lecture.

The Gems and crystals, described in the latter part of the lecture of metamorphoses, deserve also a place here, as hereafter in two places more; being not only new in this part of the world, but valuable also in their kinds. The reason of mentioning them in the catalogue, was to describe their natural forms; the reason of mentioning them here, is to describe the places of finding them; the reason of mentioning them in the physical lecture, is to assign the physical causes of the productions, and the reason of mentioning them in the physico-mechanical lecture, is to show the uses that are made of them, after they pass through the hands of artists, as well as the religious and civil regard that has

early been paid to them in these last respects.

Very little will suffice for the purpose of this lecture. All Gems contained in our catalogue were found loose upon the shores of Lough Neagh, in the compass of very few miles, to wit, between (v) and (s) as markt in Grierson's map. The large crystal in particular weighing two pound two ounces, whose surfaces are delineated in a diminished form *, was found at (a). And the fragments of a very large and beautiful colourless crystal elsewhere mentioned in these lectures, and presented

to a worthy Gentleman in Dublin, was found in a turf bog, on the very furface of it, about three miles into the country. Mr. JOHN STOTHARD in the neighbourhood of the lake; a Gentleman of the highest estimation where honour and generosity bear a price, two GEMS like those natural gems in the breast-plate of Aaron, which contained all the tribes, as these do all other virtues, was the worthy person upon whose authority this was related. It was likewise in part of his demesne, that the Inquirer found some of the agats, as well as at a hill (p) about five miles from the lough, in the County of Antrim. In the same hill was found a great deal of Talk. For a large vein of it was discovered some years past, when the late Lord Viscount Conway was searching for coals. Upon the shore of the lake near the river Main, were found the brown crystals mentioned in the lecture of metamorpholes; and also page 94, where there was a reason for mentioning the Well, called Cransield, which in some measure made it expedient to anticipate this part of the design: Referring therefore back to what is faid of the well, here it is necessary to bestow some words upon a remarkable bed of that crystalline matter about four miles distant from the well, and very near the mouth of the · river Main.

For some space along the shore, in that part of the lake, is a kind of quarry, of a fort of rotten stone, or a rock that has hardly consistence, sufficient for the most ordinary building; for a peasant broke it up pretty easily with a spade. Between the interstices of this rock, which in many places were of two and three inches breadth, transparent brown crystals grew, shooting one into another, so as to make a close and compact congeries. They seemed to grow from each rock, in such manner, as to fit themselves into the irregular interstices of those growing from the opposite rock, that no void space was lest, in which a pin could penetrate: The sigures of these can not be determined. For they are of all forts of irregularities. Yet the whole mass is exceedingly like that of brown sugar when it is candied; that is, when the mass is of the beautiful and elegant kind. For the generality of it has a great degree of soulness in it, and has no fort of beauty.

These crystals are extremely brittle, not being capable of being applied to any sort of use, in respect to the decorations of human apparel.

Masses

(p) Called Megabery, being the estate of the Right Hon. the Earl of Hartford.

Masses of them would become grottos exceedingly well; and by digging sufficiently deep, great quantities may be raised. Towards the upper part of the shore, where the lake reaches only in its highest state of flood; there is a sort of a sod, the greatest part of which is this crystalline matter, kept together seemingly by the roots of the grass which grows amongst it.

These crystals along with some of the white kind, both of Lough Neagh and Kerry, were put into crucibles, and submitted to the influence of intense heat, the result of which is exprest in the following let-

ter of a young Gentleman already mentioned with credit.

'The brown brittle matter like sugar candy of Lough Neagh, became lime in an hour, in an air surnace, and after six hours it did not seem to be altered farther.

· The white crystals of Kerry and Lough Neagh were put into cru-· cibles, which were put into an air furnace with a very strong heat.

After one hour one crucible was removed, and the crystals seemed to

have undergone very little change, more than acquiring a reddish colour, which perhaps may have been occasioned by sulphur, which had

been burned in the same crucible before.

After fix hours the other crucible was removed from the fire, and the crystals, I thought, seemed more bright than before, and more

brittle, and had many cracks in them, but no other way altered.

ROBERT DAVIES.

In the abridgment of the Philosophical transactions, the brown crystals which became lime in one hour, and perhaps sooner, are mentioned, Vol. 2. Page 464. being an extract of a letter from Sir Robert Redding.

I fend you herewith some stones of an amber colour, taken out of a spring called Cranbourn spring, near Lough Neagh, which the country people tell us, grow at the end of a little rush, and drop

off, and are to be found only on May-day eve, and good for God

'knows what: They look like the germinations of some of your falts but in the fire give no signs thereof by crackling: They are electrical

of and angular, and being pounded, the powder is white.

To which he might have added, had he tried, this powder ferments with spirit of vitriol. If they are electrical, it is in so small a degree as scarce deserves notice.

This

Historical L E C T U R E IV.

This account was taken hastily from the people of the place; they are found in plenty two miles from the spring, and any time in the

year.

Although these substances are here called crystals, yet perhaps it would be more agreeable to the distinction of things commonly used by the naturalists, to call them fluores; which are substances, inserior to crystals, as some say (s); were it not that these tho very brittle, almost splitting with the pressure of the nails, yet do not flow in an intense fire to a liquid metal of glass, if that be what some naturalists mean by fluunt.

Doctor Woodward says of sluores; they do not flow but are calcined by intense heat, and are useful in susion of metals, as lime by absorbing the sulphur, which would otherwise prevent the metal to slow.' The experiment therefore mentioned is to the purpose, and determines that these are sluores in Doctor Woodward's sense, becoming lime. And by a hammer or pestil they are easily reduced to a white powder.

(s) Schuitzer says page 242. iter alpinum. Lug. Bat. Ita videtis in crystaliorum consortium accerso sluores, ita a sluendo dictos, quod in igne fortiori sluant & metallorum sluxum promoveant——A crystallis non different nisi inferiori mollitiei gradu, ita ut gemmas nobiliores durissimas, crystallos duras nec tamen ab igne liquabiles, & sluores molliores in igne sluxiles hexagona plerumque sigura gaudentes subordinanda invicem putem.

'The specimen described by Woodward under the character of a glossy, talky, yellowish.

fpar, somewhat resembling brown sugar candy, is perhaps of this kind.

Cat. Engl. fossils, part I. page 148, 150.

PHYSICAL LECTURE,

ORAN

E S S A Y

TOWARDS

Solving the Phænomena described,

BY

Affigning the true, or most probable Physical Causes.

LECTURE V.

There are certain waters which condense wood, and other light bodies into a stony matter, so that the lower part of the body, which was under the water, shall be stone, and that above, remain wood; and hereof I myself have seen instances: This is a particular which should be well inquired into, as it may afford great light in the practical business of condensation.

History of Condensation &c. by Lord Verulam, abridged by Shaw.

I see not, why natural knowledge must be more prosperously cultivated by selfish naturalists, that aim but at the pleasing of themselves in the attainment of that knowledge; than those religious naturalists, who are invited to attention and industry, not only by the pleasantness of the knowledge itself, but by a higher and more engaging consideration; namely, that by the discoveries they make in the book of nature, both themselves and others may be excited, and qualified, the better to admire and praise the author.

Boyle, Excellency. of Theology, &c.

The things, which these proud men despise,

(And call) impertinent, and vain, and small,

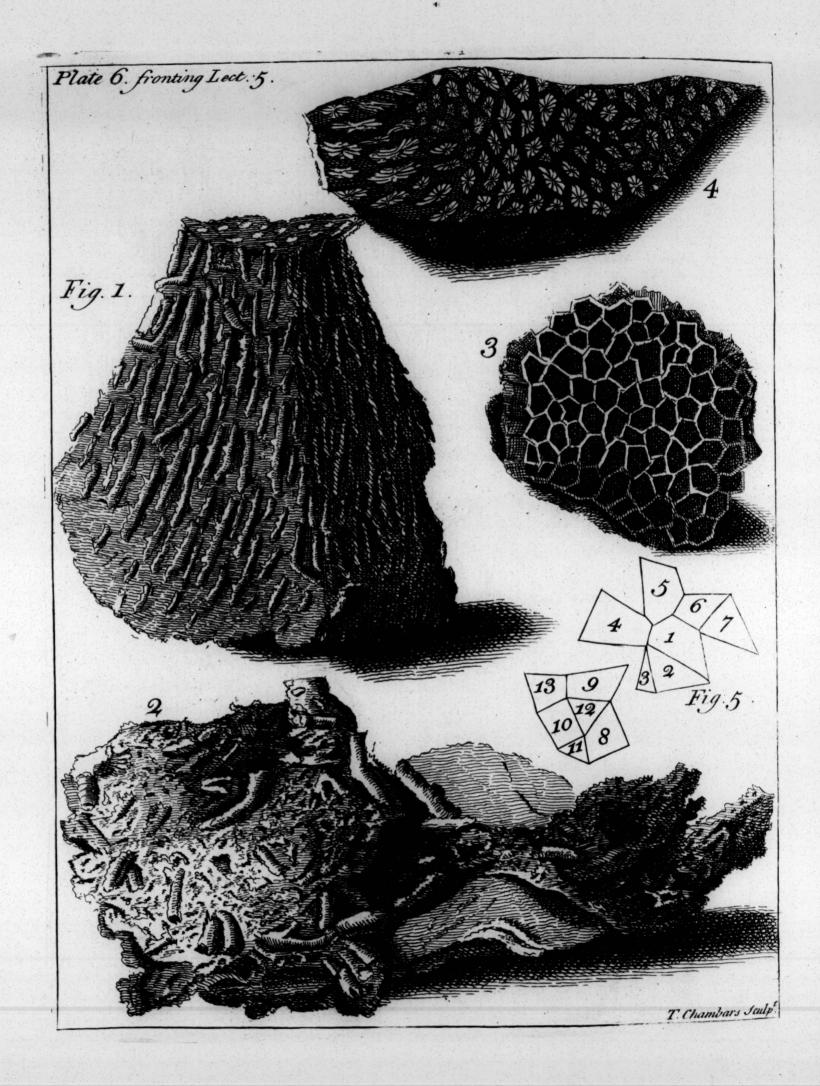
These smallest things of nature, let me know,

Rather than all their greatest actions do.

Cowley.

.... . .





LECTURE V.

BEING arrived at a main part of our business, to give the physical causes of the phænomena described, there can be no better introduction than the model of the noble design, of the foundation of the ROY-AL SOCIETY in England, as the excellent historian relates it *.

AL SOCIETY in England, as the excellent historian relates it *. · Their purpose is, to make faithful records of all the works of nature or art, which can come within their reach; that so the present e age, and posterity may be able to put a mark on the errors, which have been strengthened by long prescription; to restore the truths, that · have lain neglected; to push on those, which are already known, to · more various uses, and to make the way more passable, to what remains unrevealed. This is the compass of their design. To accom-· plish this they have endeavoured————and studied to make it not only an enterprize of one season, or of some lucky opportunity; but a business of time; a steady, a lasting, a popular an uninterrupted work.—Our churchmen the greatest and most reverend, by their care and passion, and endeavours in advancing this institution, have * taken off the unjust scandal from natural knowledge, that it is an enemy to divinity.——We are to overcome the mysteries of all the works of * nature, and not only to profecute fuch as are confined to one kingdom, or beat upon one shore.

With regard to these excellent sentiments of a most honourable society, the foregoing, present, and sollowing lectures are compiled; and for which that excellent writer has already sufficiently apologized; it being highly becoming a clergyman, to interest himself in the phænomena of the natural world, which is the handy-work of God, whose minister he is, and whose works are the objects of study, to the members of that noble

^{*} Sprat, Part II.

noble fociety, who have eminently diftinguished themselves near a century. Yet we can not enter upon this part of our task, which now is incumbent upon us, without some more of that writer's elegant and moral sentiments, which equally concern the speaker in philosophy, and the hearer; the writer, and the reader.

· What great things can be expected, if mens understanding shall be, · as it were, always in the warlike state of nature, one against another? · If every one be jealous of another's inventions, and still ready to put a stop to his conquests? Will not there be the same wild condition of · learning, which had been amongst men, if they had always been dis-• perfed, still preying upon and spoiling their neighbours? If that had · still continued, no cities had been built, no trades found out, no civi-' lity taught: For all these noble productions, came from men's joining ' in compacts, and entring into lociety. It is a ulual laying, where the · natural philosopher ends, the physician must begin, and I will also add, * that the natural philosopher must begin, where the moral ends. It is requifite, that he who goes about fuch an undertaking, should first * know himself, should be well practised in all the modest, humble, friendly virtues; should be willing to be taught, and to give way to the judgment of others. And I dare boldly fay, that a plain industrious man, so prepared, is more likely to make a good philosopher, than all the high, earnest, infulting wits, who can bear neither partnership, one opposition. The chemists lay down, as a necessary qualification of their happy man, to whom God will reveal their adored elixir, that • he must be rather innocent and virtuous, than knowing. And if I were to form the character of a true philosopher, I would be sure to make * that the foundation: Not that I believe God will bestow any extraordinary light in nature on fuch men, more than others, but upon a bare rational account. For fuch men, whose minds are so soft, so vielding, to complying, to large, are in a far better way, than the · bold affertors; they will pass by nothing, by which they may learn;

they will not contemn the fruits of others diligence, they will rejoice to see mankind benefited, whether it be by them-

they will be always ready to receive, and communicate observations;

· felves or others.

Intending to use the modesty here required, and hoping for the humanity and tenderness described, we now enter upon the business.

THE DESIGN of the present lecture is to speak concerning the causes

of the petrifications, the specimens of which still lie in your view.

Before this subject can be fairly handled, it may be proper to say something of the manner of explaining natural phænomena, and to determine, when an appearance may with precision be said, to be accounted for.

The appearances of natural things are infinite, and the fancies of mankind as much fo; he knows most of nature, who has observed most appearances with judgment and memory, so as to make comparisons to find out the regular course of things, that is, the laws by which the material world is governed. For the Author of nature always acts wifely, and is not under a necessity to make new laws for new occasions, but has fixt the course of things, and never deviates from THAT; except upon some extraordinary events, to demonstrate, for the sake of moral agency, his power over the matter of the Universe. When that is the case, the defign is always declared; but when no fuch defign is declared, the common laws of the Universe, must be the solution of the uncommon, as well as of the common phænomena of the Universe. For the solution of a phænomenon is, the attributing of it as an effect to its proper and immediate cause; for if that is not allowed to be a solution of it, inquiries become endless, or are immediately stopped. For if the cause of a cause, of a cause, is asked without limitation, the human mind has no place to rest; and if every phænomenon is immediately resolved into one common cause (k), the Divine Will; all inquiry should cease. But the course of things must oblige us to confess, that although the author of natural things does every thing by his will exerted according to wisdom, yet he chooses in a great variety of cases, to act by the mediation of instruments of his own contrivance; and yet every instrument is inactive without his immediate activity upon it. Whether or no it were not becoming infinite wisdom, to act immediately without such mediation, suits not this

⁽k) In miraculum seu voluntatem Dei extraordinariam resolvitur, ad quam tamen in physicis sine necessitate confugiendum non esse, convenit inter intelligentes.

Friend Chem. Append.

this place to inquire. Natural philosophy is that part of knowledge which shews the course of things in the material world; and an appearance may be faid to be accounted for, when its order is shewn in that course of things, that is, when the immediate cause of it is assigned: If the appearance be out of the reach of experiments, then something similar is considered, and the cause of one is very justly said to be the cause of the other. For the Author of Nature does not mean to puzzle the students in this course of things, but to the same effects for the most part gives the same causes, and if the refraction of light occafioned by human art, exhibits an artificial rainbow, fo does the refraction of light in globules of water raifed in the atmosphere, exhibit a natural rainbow.

To come nearer therefore to the business in hand, it shall be demon-

strated that all water has a principle of petrification (a).

The crust which grows upon copper (b) vessels, in which water is boiled for common beverage, is a good proof of this, together with the disorder incident to human bodies called the stone (c). For all beve-

(a) This should have taken place in a preceding lecture, if the closeness of the relation to the present purpose when the truth of it should be fresh in the readers memory, was not a good reason for inserting it here. And because a late writer (Mr. Hill) has very well handled this matter, the text remaining as it was before our acquaintance with his book, his sentiments may be considered also.

(b) There is no water perhaps, that will not occasion a crust in kettles, of the form of those which are used for tea, wherein the water frequently continues long boiling, and the vapour is much confined, in so much that the incrustation has sometimes been observed in

the lid of the kettle, where the vapour alone could be the cause.

(c) Warmth has a considerable share in the production of these phænomena. To this

purpose see the following narration concerning Hierapolis in great Phrygia.

R. Pococke, his description of the East. The warm waters here, are the greatest natural curiosities in Asia; they rise to the south of the theatre in a deep balon, and are very clear; they are only tepid, have the talte of Pyrmont waters, but are not fo strong, and must have in them a great quantity of sulphur: They do not drink them, tho' I could not perceive either falt or vitriol in the tafte of them, to make them unwholfom. The fprings flow to plentifully that they make a considerable stream: It is observed by the antients, that these waters were excellent for dying, and that the roots of the trees in this place, gave a tincture equal to the scarlet and purple; and now there are shrubs growing about the hill, the roots of which are incrusted with a petrification of these waters, which might be used in dying. The water now runs in channels about three feet wide, which are incrusted on each side to the thickness of rage however rendered palatable by mixtures and brewing, and flavours of particular plants, acquired in the manner of natural growth, is really water as to its principal content (d). The river Sein which passes through Paris, is remarkable for incrusting the inside of water pipes with calcarious matter, so as to stop the flux of water in them; and it is not uncommon in that city, to cut for the stone in human bodies, at the age of seven years. But this is not an universal connection of effects, the

about half a foot. The fide of the hill where the water runs, is covered with a white incrustation, and the channels which conveyed it through the city into the plain, are intirely filled; as well as the arches of the aquæduct, all appearing like the folid rock; and I observed towards the brow of the hill, some hollow parts, where the rain water has settled, round which there are partitions of a white sulphureous incrustation, probably occasioned by the motion of the water in windy weather; and in some parts there are little heaps, which appear like white salt, but are solid stone. In one part where the water runs down the hill, it forms a most beautiful hanging petrification like rock work; the sides of the hill appearing as white as snow; and possibly they might call this place Pambouk-Kalesi (the castle) from its resemblance in whiteness to that of cotton.

Upon this account of the learned traveller, it may be remarked that the warmth of the water, contributes greatly to the production of the above mentioned phænomena, and is similar to those common amongst us in the tea-kettles. The particular phænomenon in the cavities towards the brow of the hill, might perhaps more truly be attributed to a steam arising from the warm water, which would produce this effect best in calm weather. For wind would dissipate the matter. And the same phænomena would frequently appear in the lids of tea-kettles, were it not for scouring which they easily admit.

If this water was cold, perhaps it would not produce any one of these phænomena. See also Kircher in his Mundus subterraneus. Lib. V. Sect. 2. § 7.

Prope Roncolanum Senensis territorii oppidum duos sontes calidos observavis quorum aqua per canales ad molares rotas vertendas ducebatur. In hisce canalibus Gyperus, junci, ranunculus, similesque herbæ tanta adolescebant fæcunditate, ut quotannis eas, nè aquæ motum interturbarent, extirpare oporteret, extirpatas vero projectasque in vicinum locum, herbas omnes in lapidem conversas non sine admiratione spectavi. Cujus rei causam cum a molitoribus quærerem responderunt, aquas issus modi hujus virtutis esse, ut quæ intra Canales aut in ipsa aqua excreverint herbæ, mox ac extirpatæ suerint, lapidescent, quæcunque vero

Kercher, Mundus Subterraneus. Lib. V. Sect. 2. § 7.

(d) Non aliter inter se discrepant sluida, quam sigurâ magnitudine, viribusque attractricibus corpusculorum, quibus humor aqueus imprægnatur, qui communis, omnium sluidorum basis videtur esse. Unde tot aquarum genera virtute dissimilia? Estne quod salium acmineralium corpusculis saturentur? Quid diversum vinum quid cerevisia habet, præter particulas uvæ hordeique in aquâ innatantes? Nonne omnes etiam spiritus, ex particulis salinis aut sulphureis in aquâ dissolutis constant?

Ja. Keil. Tentamen quartum.

extra aquam in campis patentibus excreverint herbæ, istas extirpatas nunquam lapidescere.

same water that petrefies inanimate substances, does not always produce this distemper in animal bodies, when it is used as beverage (e).

This may be exprest otherwise, and also demonstrated in another

manner.

LEMMA.L

All water is capable of hardening into stone.

DEMONSTRATION.

In most or all subterraneous apartments formed by nature, and even in artificial vaults, lapides stalactites are found; the Inquirer has found them himself in several caves, he has heard and read of them in many more: Now as the gravities of all bodies, is afferted upon experiment being made upon many without an exception, so also may this property of water be afferted, from these phænomena being observed in all parts of the world, under the same similarity of circumstances. The reason why these phenomena are more frequent in caves, than elsewhere, is, that the water flows there very gently, there being no agitation of the air, so as to form pendent drops, some of which hardening above, begins a conical hardened substance; more water flowing covers that with a thin coat, which also hardens, and partly forms a liquid drop at the end, which either hardens there, or falls and begins another cone below, which sometimes increases and rises in proportion, as the upper cone increases and descends; till at last in some instances, the cones

(e) Having visited the incrusting spring formerly mentioned, I observed, that about the spring head there was only little moss incrusted; but forty or fifty yards from it, where the water hath a fall higher than my head, it sheathed every thing with stony cases, and makes the sides of the bank hard rock. It bears soap, freezes quickly, and waters ground with advantage; it is used in the kitchen and brew house belonging to the Gentleman in whose ground it rises, without any sensible ill effects; except that his horses are short breathed. Extract of Mr. Locke's letter in Boyle abridged by Boulton, Vol. II. p. 368. See also Boerhave Elements of Chemistry, page 352, London 1735.

There are some waters which are endued with a petrefying quality, as is observed in the petrefying cave at Burgundy, about a mile distant from Quingey, where the water as it drops down, petrefics into statues of all kinds of figures, Journal des Scav. 1688 p. 432. And yet what is particularly surprizing, these petrefying waters do not generate stones

in the human body. Mem. de l'Academie roy. des Scav. 91, 92.

meet, and form one continued pillar. In many cases where the water passes through one small aperture, it preserves a perforated cavity through

the length of the stalactites.

If every cave does not afford specimens of the stalactites, it is because some of them are dry and cold; or perhaps the water flows, in too great abundance, and too rapid a motion; for the quantity and motion should not cause a stream but drops, and the cave should be free from all intercourse of turbulent air, and should also be warm, that this seemingly lapidescent vegetation, or rather accretion, may be perfected (f). The stones thus formed sometimes take a sine polish, and may

(f) Petrifications of matter denser than water, may be formed in various manners. The following account of petrifications relate to this. London Evening Post, Nov. 29.

It is not easy to enumerate to you, the many improvements of which Gibraltar is capable. An able hand might here find materials for a natural history—————You have the common sand petressed into so hard a stone, that the platforms for the great guns, are made thereof, as the most durable of all others; and you see the gradual progress of this petrification.——There are two models of the works made, which are great curiosities. The bodies are composed of sand strongly cemented with oils, and now become a very hard substance, &c.

This account may be compared with Pliny, Nat. Hist. lib. 35. cap. 13.

Quis satis miretur pulverem sive arenam in puteolanis collibus opponi maris sluctibus mersumque protinus sieri lapidem unum inexpugnabilem undis, & fortiorem quotidie, utique si-

Cumano misceatur cæmento. Eadem est terræ natura & in Cyzicena regione.

At Dunlery near Dublin, there are large congeries of gravel fallen from a very high bank, and some years exposed to washing and sprit of the sea, which although so loose at first, that with a singer the pebbles might be pickt out of it, in a short time became so hard, that a smart stroke of a hammer may break the prominent pebble, without loosening the part cemented to the mass. There are hardened masses of the same kind, on the shore between Tralee and Dingle: Also masses of petresied clay at Youghal, of a bank about 90 feet high, called clay castle, which it is feared will not long be a sufficient barrier to the sea, although the sea seems by its petresying quality, to be disposed to make a barrier to itself.

There are many large congeries of mixt matter, consisting of sand; gravel, and hardened clay, found in and about the Irish Lake, even concretions of sand are found in the cavities of the petrefied wood, as some specimens in the catalogue demonstrate: But the petrification of the wood, is a very distinct phænomenon and is owing to another cause; as what follows will plainly demonstrate. As well as that the stony concretions upon the teeth of man, which sometimes require filing is a different phænomenon, and is owing to another cause, than the offisication of the man, whose skeleton was some years past in the possession of Dr. Barry, Vice-Precident of the Physico-Historical Society, and is still.

The muscles of this man's arm was almost totally turned to bone, and there grew one strong bone from the occiput down the neck and vertebræ of the back, so as to render him incapable

be wrought into urns, and vases of other forms, a beautiful one may be seen in the collection of Mrs. Delany, at Glasnevin near Dublin, a lady of whom we have occasion to speak in the handsomest manner in another place.

But we must distinguish between three kinds of petrification, besides

water petrefied.

I. Such as exhibit only a crust upon the surface of the body, specimens of which are to be found in many fountains, on moss and leaves of trees; when the internal substance is sometimes wasted, sometimes it is not.

A second kind is that, where the surface is not only incrusted, but the pores of the body are in several places so filled with petrescent matter, as to acquire the nature of stone, with the visible appearance of the first substance; in other places the petrescent matter not entring, leaves the body in that part in its first form.

* A third kind is that, where the petrescent matter, has so saturated the whole mass, that it has totally acquired the nature of stone, retain-

ing only the visible appearance of the former substance.

That there need be no ambiguity in these distinctions, or the reasoning consequent to them, it is necessary also to distinguish accurately wood and stone.

Wood is a body fibrous to the taste, tough, and capable of having its parts separated by an edged tool, by pressure alone; exciting the idea of a hollow sound upon being struck, and emitting fire upon violent friction, but not upon a stroke; and when set on fire, blazing and consuming to ashes.

Stone is a body gritty to the taste, brittle and incapable of slexion, blunting the edge of tools, whose parts are scarce separable by pressure, but more casily by a stroke, which excites the idea of a brisk sound,

emitting

incapable of flexion. It is hoped the literati will be informed of this extraordinary appearance of an animal body, by an accurate description, under the direction of the proprietor: There is in the Natural and Civil History of the County of Cork, published last year in this city, a short account and graving; which Mr. Smith the Author (mentioned page 63) would probably have given compleatly, if the honour of that was not left for the worthy possession; whose great business in the medical way, has retarded his design. The calculary of some pears too hard for teeth or knife, is a phænomenon proper to be considered along with this; as well as the stony concretion which sometimes grows upon the teeth.

* Mr. Charles Mason's first Letter, not prefixt to these Lectures, mentions distinctions

fimilar to thefe.

emitting fire upon friction, and also upon a stroke, and bearing a great

degree of fire without confumption.

Because some mention shall be made and has been already, of bone converted into stone, it may be proper here to state also the true properties of bone as distinguished from stone. Bone will yield to a knife so as to part in slices larger or smaller, according to its thickness, which stone will not do(m), tho in some instances it may be broken thereby into irregular lumps; small fragments of stone are gritty between the teeth, but these of bone are not (n). Bone may be softened into a mucus

(m) It is to be wished the answer to the following query was fuller. Stone may split in a grain like wood, but not curl like chips, or ligneous shavings.

Q. Whether the quarries of stone in India, near Feticopa, not far from Agra, may be

cleft like logs, and fawn like planks, to ciel chambers and cover houses.

A. What they are about the place mentioned, I have not as yet been well informed; but in Persia not far from Cyrus where the best wine groweth, there is a fort of hard stone, which may be cleft like fir-wood, as if it had a grain in it; the same is at the coast Cormandel about Sadraspatuam; where they make but a mark in the stone, set a wedge upon it, with a wooden hammer, as thick, and thin, as they please; it is used commonly for pavement in houses, one foot square, and so cheap, that such a stone sinely polished costs not above sixpence. Sprat. History of the Royal Society.

There are accounts given of wood in America, answering many purposes of iron and stone. Marvelous things concerning vegetation we do not chuse to relate, unless they are extremely well attested, and concern the subject in hand. Yet one thing, of which the Inquirer was an eye witness, he will take the liberty to mention here, not knowing where else he can so properly introduce it, and being a phænomenon of great novelty to him, per-

haps it may not be quite familiar to the reader, and therefore agreeable.

In the gardens of the Reverend John Standish, near Lough Neagh, a Geutleman, who is too well satisfied with the truest retired worth of a good Clergyman, to desire praise here, the Inquirer was informed by that worthy person of an extraordinary growth of Colewort, which he had to shew. It was a tall plant amidst many others, pretty much of one stature, growing under an apple tree: Each leaf had upon the middle stalk, and also in other parts of the leaf a great number of similar plants, growing from it in miniature, with the intire surniture of stalk and leaves; to the height of three and six inches. For they were of different statures. Every leaf supporting a little garden, of this kind, to the number of ten or a dozen, made the whole plant of a very beautiful appearance. The present Lord Bishop of Kildare dining there one day, a leaf was brought into the house to be shewn to him. The proprietor meant to have preserved the plant, to learn what the issue of this uncommon vegetation would be, but his gardener indiscriminately pulled it up with the rest, at an unfeasonable time.

(n) The yoke of an egg may be hardened, so as to appear to the fight and touch to be beautiful amber, yet shall dissolve in warm water; bone may be a kind of hardening of slesh similar to this, capable of dissolution in the heat of the digester, or even by that of the human body, as appears from the remarkable instance mentioned in Spond his travels.

Examine the specimens before you according to these properties, and you will reduce them to the last classes of petrification: Some of them

are intirely stone, in the place of what was once intirely wood; some are wood and stone so intermixt, that it is not easy to say which kind of matter has the greatest share in the composition.

Before the cause or causes of these petrifications be assigned, two Lemmas more must be demonstrated.

I. Concerning the universal attraction of matter and cohesion of par-

ticles in contiguity.

II. Concerning the effects of constant pressure, and the porosity of all bodies. These might have been propositions in the first lecture, and have been demonstrated there, but their close relation to the reasoning which we are about to use immediately, makes it more convenient to deliver them here. And although that reasoning depends also upon a conviction of the truths demonstrated in the first lecture, yet those of immediate application in reasoning, should have also proximity of situation.

LEMMA. II.

Every particle of matter attracts every other particle of matter, and when brought to contiguity there is a strong cohesion.

DEMONSTRATION.

The material masses of which the world consists, are all kept in their forms by this principle; and whatever brings the particles of stone together, it is this principle that keeps them united. Hence it is that loose clay, when tempered and made into the form of brick, shall be able to support a pressure in the corner of a wall several thousand times its own weight. Even these particles of matter which seem to repel each other at particular distances, shall most closely unite when brought

to contiguity. Such are the particles of air which entring the porce of other bodies, unite and constitute part of the mass. This cohesion in some instances seems to increase by time, as the mortar of old walls is sometimes so hard, as scarce to admit the penetration of a tool, when that of new erected buildings will easily crumble.

Some fluids containing falts, must be allowed several months (p) and some of them years, before the attracting particles will form their union and strike into sigures. And whether there be not matter in the silent chemical chambers of nature, that may require ages to form a coalition can not positively be gainfayed without the imputation of rashness.

L E M M A. III.

A continuance of an equal pressure tho gentle, shall conquer a very considerable resistance, seemingly inadequate to its force.

DEMONSTRATION.

There is something very surprizing in the nature of pressure, as indeed there is in every phænomenon of nature, when considered attentively; all is Miracle. A quick stroke from a soft body, shall penetrate an exceeding hard body; and a slow pressure of a soft body, shall also penetrate an exceeding hard body; but in such cases is meant, a very slow degree of slow pressure, and a very quick degree of the quick stroke. Hence it is that in one case the stroke of the tail of a living whale, although blunt, and soft, shall cut an oar or a boat with a smoothness equal to that effected by a sharp instrument, and in such a manner, that he who handles the oar shall feel nothing of it. Hence it is that the roots of a tree shall penetrate into the crevices of walls, and even hard rocks, and by swelling in its passage burst them.

ALL things are now prepared for giving an answer to the question: To what cause is the production of these petrifications to be assigned? There are but three natural causes which come into competition.

S 2 Water.

(p) Quædam portiones spiritûs cornu cervini, qualiscunque esset ambientis aeris temperies, sluidæ remanebant, nonnullæ etiam ad plures menies, & exinde salina corpuscula in liquoris residui sundo incipiebant in crystallos exquisitè siguratos abire, quorum magna satis copia tandem se prodebat. Boyl. de Fluidate & sirmitate, Genevæ,

Water. The external air of the globe; and the internal air of the globe.

Is water the cause of these petrifications?

Water it is certain is a fluid of a proper density or weight, to carry calcarious particles of matter along with it, when it flows in a dense body or stream; and if it rises in the form of vapour from the lower parts of the earth, it is extremely infinuating, perhaps more so than air; and is in this respect a fit instrument for the production of these rare phænomena; an instrument I say, because it is in this sense we use the word cause, when we inquire into the production of natural appearances, there being in the true meaning of the word cause, and the true sense of things, but one cause of all things. And when we speak of matter acting upon matter, and the forces of bodies upon one another, and phænomena thence arising, we speak only according to the vulgar: For matter can not act at all, but is in all cases only acted upon by some intelligent Being, which alone can have a principle of motion.

A stream (e) of water in the copper mines of the County of Wicklow, conveyed the particles of copper in such abundance, that an iron pick-ax which happened to lie in the course of it, was in a short time totally corroded, but there was a substitution of an equal quantity of copper exactly in the form of an ax. In the same manner water may convey particles of stone, according to the strata of earth it flows through, and being very infinuating it enters the pores of the wood, and deposits

ire

(e) Doctor Woodward in his catalogue of foreign fossils annext to English fossils, page 52 gives the following account of a specimen called iron turned into copper, from a spring near the copper mines of Hemgrunt in Hungary.

'These springs, rivulets &c. that arise out of the copper mines here, are impregnated with much vitriol; in which there is also copper dissolved. Indeed the vitriol constitutes a kind of menstruum. Upon the putting iron in, that menstruum preys upon it, and assumes the ferreous parts into itself: At the same time it precipitates an equal proportion of the cupreous parts; a thing common and well understood by refiners, and all who have been conversant with solutions in aqua fortis and other like menstrua.'

This may explain what we are told by some persons, that they make copper out of iron to profit, at Newsohlin Germany. See Shaw's edition of Bacon's works, Vol. I. p. 28.

Of late we are come into the practice of making considerable quantities of copper, in the Gounty of Wicklow in Ireland, by means of iron: For one tun of iron laid in form of bars in a small stream issuing from the pit, in seven weeks produced one tun of copper almost malleable, there being only one quarter of the iron corroded: This practice is becoming very profitable.

its burden: For the delay of motion which must necessarily happen, allows time for subsidence; when the stony particles are come thus together they adhere, and by long continuance the attraction becomes very strong, as was demonstrated in the second lemma.

Sometimes the pores of wood are too close to admit the stony particles, as seems to be the case of many of these mixt specimens, whose firm wood tho' taken out of a bed of water, if examined immediately is found dry in the heart. Sometimes the wood is porous and fost so as to admit the water too plentifully, and allow too free a passage: This must occasion motion, an enemy to petrification; for petrification seems to require rest, when the matter proper for it is brought together (g).

That these petrifications are effected in this manner, seems also probable from an appearance often discernible in them: if the stones are cloven when the petrification is compleated, one may by rubbing the soft part of the hand upon the inner surface, roll up some fibrous parts of the wood which still remain. So that there does not seem to be a destruction of the former substance to make way for the new, but rather the former substance remaining has its pores so filled with the new, as to acquire new qualities, and a new name. In confirmation of this, if the cloven pieces in which the sibrous parts of the wood may be rolled up, be thrown into a culinary fire, they will not only burn red hot, but also blaze in a faint manner; and thereby having all the wood consumed,

they

(g) In the heart of the specimens of petrifications here treated of, beautiful crystals are sometimes formed, and Friend's remark (Chem. de crystal:) as to the circumstances of rest is here applicable.

lidem vero sales aquâ calidâ soluti in eâ facile colliquescunt & sustinentur, nec quamdiu ea calorem retineat, in crystallos concrescunt. Motu quippe quem calor excitat vigente præpeditur atque destruitur omnis ille motus a vi attractrice oriundus. Cum vero aqua refrixerit & in se ipsa tandem quieta resederit, sales propriore viciniâ potiti ita vim attractricem exerunt, ut inter se coire possint & in crystallos essormari.

And what Boerhave says, El. Che. p. 3, process 1. is to the purpose.

These waters I have kept in vessels very closely stopt, and let them stand very quiet, and after a year I have observed this mucilage began to be formed, and every year grew gradually larger, till the whole water was grown turbid. This liquor contains elementary water and the spiritus rector of the plant.

Is not the tartar of wine incrusting the sides of vessels, and the mother of vinegar also to the purpose?———As to what has been said of incrustations of tea-kettles &c. There is both warmth first, which implies motion, and rest afterwards; water being often allowed to stand to cool.

they become more porous and light; and if they are put into the fire a fecond or third time, they will only grow red hot, and will waste no farther (h). The air upon the land effects this by corrosion, in a slower degree, but at last makes the black weighty stones become white, po-

rous and light; fuch as they are commonly found.

If it should be thought that the sand of the lake, which in many places is very fine, being conveyed into the vessels of wood, may coalesce, and form a mixt substance of stone and wood in some specimens, and totally stone in others: Because some fragments have been sound on the shores, with some particles of sand closely adhering to the surface, and seemingly in continuity. It may be answered, that the petrification is not effected, by means of the sand of the lake, because the specimens of petrification hitherto tried in great heats, will not vitrify or run into glass, which the sand of the lake is known to do. For the manusacture of glass was sometimes carried on in the neighbourhood of it, in which the sand of the lake was used to good purpose, till the dishonesty of workmen put a stop to it. This method therefore of accounting for the petrifications is not so probable as the other.

The former account might possibly suffice was it extensive enough. But in as much as petrifications are found not only in the lake, but in the raised land all about it, even eight miles from it in gravel pits, or rather banks or hills of dry gravel, where water seems to have very little commerce: Some other cause must be assigned, that may extend to all cases. For the Author of nature does not multiply causes, to produce the same effects unnecessarily. Let the external air of the globe there-

fore be considered as a cause of these phænomena.

Is the external air of the globe the cause?

Air has been proved to be prædatory, and destructive of the forms of all bodies, which once in a growing state received their forms by its aid, petrification therefore cannot reasonably be attributed to it. The nature of wood when the progress of vegetation is stopped, is to rot by means of the penetration of air, which is a fluid ever in a state of oscillation, and consequently motion, as nice Barometers sufficiently testify, and is also ever changing its nature, by a discharge of some particles, and re-admission of others. And being also an exceeding light sluid, some hundred times lighter than water, it is not likely to bear up the particles of stone.

By

(h) See Lecture III. Number C. to CLIII. May not this property be turned to useful

purposes, in making crucibles.

By propositions (i) in the first lecture it is certain, that the increase of surface by the division of the heaviest body, is very great and infinite; by proposition (5) of the same lecture, matter is capable of infinite division.

And from the laws of hydrostatics, although heavier bodies do not fwim in lighter fluids, that is, fuch gross bodies whose surfaces contain more matter, than the same surfaces would contain of the fluid, sink: yet these bodies being comminuted will swim, as appears from the corollary of the first lecture. Hence it is that it is possible by division, to comminute gold or stone to such small particles, that each shall contain within its surface less matter, than is proportionable to its surface; consequently each particle shall swim in air as effectually, as if lighter than so much air (n). Although this be possible and is fact; yet upon account of the other qualities of the external air, its oscillatory motion owing to perpetual changes of heat and cold, and its prædatory quality, it is not likely to be the cause of petrification. Besides all this, the principal work-shop of nature for these petrifications, is under ground, under different strata of clay, to the depth of nineteen feet, below the common influence of the atmosphere, or external air. For although these petrifications may be found, scattered upon several parts of the shore, they are rolled thither by the water from their proper beds of formation; many of which similar to the one described *, may be in the body of the lake. And although it be very rare to find them with wood; it is because the wood is worn off in the rolling, or soon crackt and chipped by the fun upon the shore, in which case it separates intirely from the mass of stone.

Since therefore the external air or atmosphere, can not amount to a general cause of these phænomena; let the internal air of this globe of earth, be considered as the physical cause of these petrifications.

The internal air of the globe, is not a distinct sluid body of elementary matter, from the air which incompasses it. For by prop. 2. of the second lecture. Air not only incompasseth this globe of earth, but pervades it. Yet the situation of the internal air, and the variety of material strata it penetrates, and the different causes which rarefy and condense it, and its not being subject to those violent agitations of storms and

⁽i) Prop. 6, 7, 8, 9, 10, 11. (n) See concomitant causes, lect. I. * Lect. IV.

and hurricanes, render it capable of producing many effects of which

the external air is incapable.

For although it holds a communication with the external air, the globe of earth being like an animal body, perpetually taking matter into it, and expiring matter out it; if not at large apertures or gulphs and cavities, that feem to swallow the sea, a prodigious instance of which there is near the coast of Norway; and by Vulcanos, such as Vesuvius, Ætna, and Hecla, by which the earth discharges rivers of burning matter; it is, besides these, perpetually expiring, through its pores vast quantities of matter, which according to the season of the year and climate, cause variety of phænomena, thunder, rain, epidemical distempers, severs and plagues. In so much that miners, whose occupation is deep under ground, can more accurately fore tell the changes of weather above, than they who live above: And this they do, from the change of heat below, and the ascending vapour, of which they are very sensible (k).

Notwithstanding this communication, the internal air is capable of producing many effects, which the external can not. For in some places the earth is bound by frost, which interrupts this communication for a time; although warm springs, which receiving their supply from below, and also heat are too powerful, for the influence of the ex-

ternal air, and preserve their fluid state in hard frosts.

Suppose

(k) About five leagues from Biçanson in France, there is a cave three hundred paces deep, which in the space of one day, when the weather is excessive hot, surnishes so much ice, that the waggons and mules are scarce able to carry it away in eight, so that it rises almost to a thickness of sour feet. And on the contrary in the winter time, it is full of vapours, and a river runs in the middle of it, which is always frozen in the summer. When any vapours are seen in this cave, they certainly prognosticate imme-

diate rain. Du Hamel. Hist. de l' Ac. Roy. des Sc. p. 257.

The communication between the internal air of the globe, and the external well understood, may explain these phænomena: The Inquirer leaves it to the sagacious reader, to consider the phænomena attentively, and to apply the reasoning here used, or his own reasoning which probably is better. In summer the pores of the cuticular earth, if one may use the expression, are open and suffer the internal vapour to expire, perhaps at some distance from the cave; in the place of which succeeds a freezing cold; on the contrary in winter, the cuticular pores being closed by the cold of the atmosphere, the internal vapour being interrupted in its usual course, is collected in the cave, and being warm must occasion a thaw.

Note also that there are chemical experiments whereby fluid matter is made to freeze

before a fire; for there are artificial colds, greater than any natural.

Hence

Suppose therefore this air, holding communication with the external air in some places and times, and suppose it interrupted in other places and times, by frosts and impenetrable strata of matter; it may be capable of expansion, and condensation from internal causes, which shall not always affect the other, except in places where the communication is very free; and even there, as it ever supports larger columns of air, than that which is external to the globe, it is weightier, and consequently more capable of bearing up particles of metal and stone, through the strata of other matter, which by attraction may detain some of the particles, and suffer a considerable change in their form.

For this phænomenon of the ascent of vapours, is frequent (1), and the matter transformed by it, has been lying in its bed or beds, (for many of them may be supposed, tho' only one has been yet discovered) ever since the general transformation of the world, and has therefore had sufficient time to undergo a change (m).

(1) Over a bath in Hungary, which abounded with petrefying particles, the steams which were arrested by the building over it, were turned into stony concretions, which may give us reason to think, that petrefying vapours raised from the lower parts of the earth.

meeting with rightly disposed matter, may form stones without the help of rain or spirits.

Boyl on Gems.

(m) Although the petrifications which are part of the subject of this book, are accounted for from the ascending vapours, yet it may be fair dealing, to let the reader know what Kircher says,

Quæritur quidnam proprie sit succus lapidificus.

Dico esse saxum nostrum aquâ eliquatum.——Si enim saxum quodcunque in pollinem tenuissimum resolveris. & aquâ perfecte commixtum per manicam Hippocratis colaveris, illa nil prorsus saxeum, sed præter arenaceum solummodo sedimentum nihil relinquet: Si vero nitrum aut Tartarum aquâ perfectè comminutum adderis, illa, quæcunque tetigerint intra subjectam concham posita, sive frondes, similiaque post exiguum curriculum aeri exposita, in saxum ejusdem generis convertent, si non totum, saltem cortice saxeo vestient.

Quandocunque aqua pluvialis aut ex nive dissoluta per montium rimas sissurasque transiens, sesse sais nitro refertis infinuat, aut slumen aliquod transierit, cujus ripæ nitrosa materia refertæ suerint, tunc aqua nitrosæ materiæ vel cum minimis ejus corpusculis persecte vel consuse per ramenta miscebitur; si prius, tunc lævis & glaber politusque lapis nascetur, in candem quoque saxeam materiam convertent quicquid sluore suo involverunt. Si vero posterius, tunc ex stillicidio aquarum intra montium speluncas sacto, rude saxeum asperum unpossitumque nascetur, quod nunc in struarum pendentium, modo in pyramidum columnarumque siguras successivo incremento exurgit, & hoc pariter quicquid involverit, in lapidem sibi similem ex quo prosluxit transmutat. Atque tales sunt omnes illæ monstruosæ siguræ retum, quas in issusmodi cryptis in saxum conversis cum admiratione spectamus. Si vero aqua sluminis lacusve nitrosa hac virtute imbuta suerit, tum herbæ & plantæ attracto lapide.

Hence is there a fair account given of all these petrifications, so as to render it probable, that they are produced by an ascending vapour, impregnated with stony or mineral particles, which if they happen to mix with the water of the lake, in their journey upward, may produce the phænomena.

scente succo, quamdiu intra aquam steterint, humido impediente molles remanebunt; evulsæ vero & in littus ejectæ tunc attractus ab ipfis lapidificus fuccus, ab aeris ambientis, humidum resolventis, calore & siccitate intra exiguum tempus veltotæ in saxum, si nitrosa corpuscula saxeis ramentis atque aqua persecte mixta fuerint, convertentur; vel si impersecte & confusanea mixtura constiterint, tunc uti ad intima substantiæ penetrare ipsis non est licitum, ita

quoque cortice tantum plantas herbas paleas ac virgulta vestient.

Quandocunque vero aquæ cujuscunque generis, præsertim intra concava montium, cum nitro & sulphure saxeæque rupis sale fætæ ramentis concurrerint, tunc succus nascetur lapidificus, qui quodcunque obvium involverit, in densam lapidis substantiam convertet: Sal enim poros aperit substantiæ, nitrum eos implet, sulphur calore suo omni humiditate expulsa totum in ferreæ duritiei substantiam transmutabit: Cujus signum est, quando ferro percussæ

tinnitum metallo œmulum similemque ediderint; cujus & hoc experimentum est, si sulphur

cum nitro concoxeris totum in lapideam substantiam abire reperies.

Quandocunque vero in subterraneis penariis aquæ succos concretos, vti pyritem, mysi, foryn, melanteriam, aut calcitim roserint, aut per vitrioli fæta saxa transserint & ramentis faxi feu glebæ quæ dictorum fuccorum, queis continentur, veluti vafa quædam funt, perfecte & intime mixtæ fuerint, tunc nascetur succus quidam petrificus, qui alterius speciei faxis glebisque commixtus, ea in saxum convertit pretiosum & pro tincturæ ratione varium; si vero hujusmodi petrificus succus calore ignis subterranei elevetur, is per intimas montium faxorumque rimas agitatus, ubicunque matricem probe dispositam repererit, aut si is nitidissimus liquor fuerit, statim pro tincturæ & exactioris misturæ ratione in transparentem lapidem pretiosum vel crystallum, Beryllum, Amethystum, Topazium, Adamantem, similesque nunc magis aut minus durum, pro falis, aluminis quantitate eidem juncta, frigore loci concurrente, indurabit, quibus una magnæ dotes ex natura fuccorum faliumque emanantes conciliabuntur inferenturque; ut proinde hic genuinam gemmarum originem habeas.

Quandocunque vero succus petrificus exvaria nitri, alumnius, vitriofi, cæterorumque salium speciebus, diversisque mineralium glebarum ramentis, acredine dictorum salium exesis, in intimis terræ visceribus commixtus fuerit, tum ignis subterranei calore succus in vaporem resolutus, atque per saxearum substrictionum fissuras fistulasque vagabundus, ubi matricem aptam repererit, ibi vel marmor variegatum ex multiplici qua pollet tinctura, vel diversa jaspidium genera constituet; & quodcunque involverit, muscosæ materiæ plantulas vicinas eas pari modo una cum faxo coagulabit, unde tot herbulæ, musci ramenta passim in lapidibus

spectantur.

Quandocunque aqua five per pluviam, five per flumen aut per arenaceas materias & faxa, nullà concret rum succorum saliumque copià referta, transierit, ea quoque propter defectum facultatis petrificæ nihil in faxum convertit: Utique in limpidislimis fontium originibus; quæ cum omni heterogenea miscella careat, ita illa quoque neque vestigium ullius faxeæ concretionis, neque in littoribus, neque in cryptarum rimis relinquet.

Mundus subterraneus lib. 8, sect. 2.

phænomena, which tradition has hitherto attributed to that water. One of the oldest instances of which tradition, is in an author of the ninth century, quoted in the Ogygia.

De tertio miraculo sic idem Nennius (sæculi noni author)

Est aliud stagnum quod facit ligna durescere in lapides. Homines autem sindunt ligna, et postquam sormaverunt in eo usque ad caput anni, et

in capite anni lapis invenitur, et vocatur stagnum Loch-eachac.

Hic est Lacus Neachus, Echac enim seu Eacha est viri proprium (quod Achaium latine verto, alii Eochodium) a cujus obliquo (Neacha) Lacus Neacus destectitur; qui quidem aquisolii ligna in cotes pro certo convertit: An vero anni, aut septennii spatio? An etiam partitur in ferrum, ut superius traditur? Mihi utrumque incompertum.

To this may be added, a passage from Tollius.

Gemmarum & Lapidum historia, Ludg. Ba. p. 534.

In lacu Hiberniæ omne quod injicitur, vel in ferrum convertitur, vel si fundum petit, in lapidem transit.

These wonders of the lake are told in verse thus.

Est Lacus Ultoniæ Neachum quem nomine dicunt, Cujus si quivis Aquilentam affigat ad imum, In tres septennis species distinguitur annis; Pars sundo ferrum, cos sluctibus, arbor aprico.

This old tradition should occasion an inquiry into three things.

I. The kind of wood which is petrefied. II. The time required for petrification.

III. Whether the wood admits of a transformation into iron, as well as stone?

As to the kind of wood continuous to these specimens of petrification before you, it may in the first place be declared, that they are not holly, although that be the prevalent opinion; that is, such of them as belonged to those diluvian strata hitherto described; for many of them being ground to a smooth surface, shew a grain that had a good deal of variety in it, and evidently different from holly, which is one smooth uniform grain. Because some specimens, which are found upon the land, and dry parts of the shore, having been long exposed to the

fun, and thereby as it were, bleached to a whiteness, and uniformity of appearance, not unlike holly, the opinion seems universally to have prevailed, that all the specimens are holly: You will see sufficient reason to deny that many of them have ever been holly; and that a few of the white and light kind have been holly, need not at present be disputed; because perhaps, some specimens of that kind with wood continuous, may be found hereafter, which will determine the matter:

Hitherto no fuch specimen has occurred to the Inquirer.

We are under a necessity to suppose this lapidescent wood, any of those kinds of wood, which grow naturally near the lake, or of those kinds which are found in plenty, in the bogs adjoining to the lake. Because it is reasonable to suppose, this petresied wood was deposited in its beds of petrification, before the formation of bogs, and even the lake itself; or the growth of these trees which are found in the neighbourhood. Trees that are allowed to grow, and are afterwards felled, must fall in such a manner, as to allow some intermediate space between them; and supposing them immediately covered with clay; that clay will form partitions between tree and tree. But here is a bed of wood of four feet thick, of considerable extent, lying so compacted together, that no visible interstice appears, and no heterogene matter with it, but water, and a few of the transformed bodies from wood to stone, and a little of the Lac Lunæ, already mentioned, p. 98.

Trees found in neighbouring bogs are commonly found single, and burnt (0) at the thick end, which helps to prove two things, both the felling them by fire, and not an ax; and also the modern production

⁽o) There was indeed found in this pit at Ahaness, one piece of combustible wood about fix pound weight, partly described Number GCLX. Lect. 3. which had in it, a great number of small pieces of matter like charcoal, evidently distinct from the rest of the woody matter intermixt with it. These lumps of charcoal were all small, none exceeding the size of a cork for a pint bottle, and some of that shape; when the piece had lain in the house some months, and being listed in order to be put in the fire for ordinary use, it was taken notice of, and the charcoal fragments appeared remarkably black and shining; the incompassing matter being of a dirty black, or rather brown colour. This charcoal crumbled easily between the singers, and became a fine black powder, discolouring the skin; it would instantly take fire when thrown upon the blaze of a candle, and being burnt, did not emit a fragrant sume, like the brown matter incompassing it, nor indeed so much of it, as the more firm wood, in the same bed of matter.

of the bogs which now cover them. The felling of trees in this manner, was a hafty method both of the Danes and English, to hinder the native Irish from sheltring themselves, in their woody marish grounds. And trees felled with boughs and leaves, are very proper to stop the course of water; the Beavers in America know this very well, who always begin their Waers in this manner, and will at last sinish a bank that shall be impenetrable to water. And they who are concerned here,

It may be more proper to ask, since no marks of fire appeared in any of the gross

blocks, how came these hither. Although no gross timber has been yet thrown up out of this bed, with marks of fire, yet some may hereafter be thrown up, when further search shall be made. And if such should be found, they will not invalidate the argument here made use of to prove this bed of matter to be formed by the general deluge. Because we are not to suppose, that timber was used for firing before the deluge: And if it was used for such purposes, it should seem probable, that wood reduced to charcoal, may sometimes be found in strata of matter formed in the deluge. Charcoal being less liable to putrefaction, than wood that has undergone the influence of fire. The particular cake of matter, which gave occasion to this note, seems to have been two twigs or small branches of a tree burnt to coal, and so intermixt with leaves pressed into a dense form, as seem at first to make one continuous body. And that leaves are capable of duration confistent with this supposition, may be inferred from the Chemist's remark, (Boerhave El. Che. part 3. process 2.) 'Who that had not seen it, could ' have believed, that distilling the tender leaves of rosemary for the space of two days, should. have not destroyed them? Nay, but which is still more surprizing, boil the small fine flower as long as ever you please, and then carefully take it out, and view it either with

Leaves which were to undergo no such torture, may well be supposed to have lasted since the deluge, and the incumbent weight might so press them, as to give them the sirmness of wood. For by artificial pressure leaves of tobacco may be forced into a narrow compass, and a hard consistence; and the sheavings of leather being closely press, may become as rigid as a board. The manner of the breaking this lump of wood, with fragments of charecoal contained in it, gives good occasion for this supposition. For it does not cleave like the rest of the same stratum, lengthways; according to fibres, but into very short, thin, irregular stakes. Probably more of this matter was thrown up at the same time, although none was taken notice of except this piece, being a piece accidentally observed to have something singular, when it was in the hand in order to be thrown upon the fire. It is to the purpose to remark from Doctor Woodward, Cat. of English sofsils, part II. p. 19. A specimen which he describes thus.

A piece of wood having manifest marks of its having been chared or burnt by the fire, before it was buried in the earth; it is not unusual to meet with wood thus burnt, reposited in the bowels of the earth. I have found it also in the peat marshes of Cheshire,
and elsewhere; and G. F. de Oviedo observed charred wood in virgin earth, i. e. earth

that had never been dug or disturbed, at a considerable depth in the mines of Peru.

V. Purchas Pilgrims, lib. 5. c. 3. p. 971.

here, in the making and preservation of banks for courses of water to mills, are well acquainted with the use of the boughs of fir, which al-

ways having leaves, are excellent for the purpose.

The water of the marish grounds being thus stopped, or at least delayed in its motion; the grass and heath growing through it, and every year dying, has in a long course of time produced large tracts of land, called turf bog, replete with various kinds of timber; such as red fir, oak, yew; all extremely useful, and other kinds of less value. Let any one examine a clod of turf of the red and soft kind, and he will find it almost a collection of withered grass, and the stalks of heath; the black turf which is the most lasting of the two combustible matters, lies commonly deepest, and is no more than the most rotten part of the bog, which must be tempered like mortar, to make it capable of being wrought up into shape for human use in suel. Large trees are for the most part found in these bogs, separate from one another, and burnt at an end, and only covered with turf (p); but in the bed of petrisications, the timber is found pressed into an heap, without any marks of fire, (except one small specimen) under and over a deep bed of clay.

We

(p) A sensible opinion concerning subterraneous trees is fully express by Mr. Ray, and Mr.

De La Pryme, in the following quotation.

The greatest number of subterraneous trees were burnt or cut down by the labour of man, in the places where they now lie. In England there are found of them, in most of the great morasses, mosses, fens, and bogs, in Somersetshire, Cheshire, Lancashire, Westmoreland, Yorkshire, Staffordshire, Lincolnshire, and other countries. The wood of them is usually

called moss wood, and is as black as ebony.

These trees I say, were anciently burnt or cut down by the labour of man, as Mr. De La Pryme does clearly make out, in a letter to Doctor Sloan, registred in the philosophical transactions Number 275. For many of these trees have been burnt, some quite through, some, all on one side; some have been chop'd and squared, some bored through, others half riven with great wooden wedges and stones in them, and broken ax heads.——And it is very observable, that upon the confines of the low country, between Burningham and Brumley in Lincolnshire, are several great hills of loose sand, which as they are yearly worn and blown away with the wind, there are discovered under them, many roots of great firs, with the impresses of the ax as fresh upon them, as if they had been cut down but a few weeks; which I have several times with pleasure taken notice of, as I rode that way.

You will ask who felled those trees? And for what reason did they fell them? Mr. De La Pryme tells us, and proves it by sufficient authorities: That the Romans did it to take

We are at liberty therefore to call this petrefied wood, by any other name than that of fir, oak, yew, or any tree growing in Ireland. The agreeable smell of it should incline us to think that it is cedar (q). It

these shelters from the Britains, and to secure their conquests. For (saith he,) the ancient Roman writers and historians, frequently tell us, that when their Armies or Generals purfued the wild Britains, they always fled into the fastnesses of the miry woods, and low watry forests. Cæsar himself confesses the same, and says, that Cassibalene and his Biitains after their defeat passed the Thames, and fled into such low morasses and woods, that there was no possibility of following them. We find also, that the stout nation of Silures did the same, when they were set upon by Ostorius and Agricola. The like did Venutius, King of the Brigantes. And Herodian plainly tells us, that it was the custom of the wild Britains, to keep in the fenny bogs, and thick marshy woods; and when opportunity offered, to iffue out, and fall upon the Romans; who were at length fo plagued with them, that they were forced to iffue out orders for the destroying, and cutting down all the woods and forests in Britain, especially all that grew on low grounds and morasses. This order was executed, and they were accordingly cut down, as is evident in many writers, who tell us, that when Suetonius Paulinus conquered Anglesey, he cut down all the woods there. Galen the physician tells us, that the Romans kept their foldiers continually employed in cutting down of woods, draining marshes and fens, and in paving of bogs. It is manifest also, they did not only do this themselves, but imposed the same heavy task upon the captive Britains. For Galgacus in his speech to his soldiers, tells them, that the Romans made flaves of them, and wore out their bodies in cutting down of woods, and in cleanfing of bogs, amidst a thousand stripes and indignities. But that which is most obfervable, is, what Dion Cassius tells us, viz. That the Emperor Severus lost 5000 of his men in a few years, in cutting down the woods, and cleanfing the fens and moraffes of this nation. Mr. De La Pryme, adds much more of the famous levels of Hatfield chase, and the adjoining countries, which may be seen in the letter quoted before.

Moreover, not only the Romans have taken this course of cutting down the woods, for the reasons alledged, but other great Generals also and conquerors of countries. So our Henry II, when he conquered Ireland, cut down all the woods that grew upon the low countries thereof, the better to secure his conquest and possession of the same, to keep the country in a settled peace, and to disarm the enemy, who trusting to such advantages, are apt to rebel.

The like did Edward I. when he conquered Wales.

Phisico Theological Discourses, from p. 232, by J. Ray. The mass of subterraneous wood, principally spoken of in these lectures, is evidently of another kind, and is fairly proved to be antediluvian. Although the remarks of these gentlemen be true concerning most timber raised out of marish ground; Yet since nothing similar to this extraordinary stratum of subterraneous timber, came in the way of these diligent Inquirers into nature, the consideration of this stratum is highly worth the Reader's attention.

is certain that bog yew, which is like it in colour, is very unlike it in smell, and so is every other kind of timber, growing or raised out of the bogs in the neighbourhood.

One

I. Generaliter. Neque enim unum genus aut debitâ copia suppeditari poterat ex una regione, aut satis commodé diversis arcæ partibus, trabibus, tectis &c. adhiberetur s.

De lignis bituminatis h. Confundit GOPHER cum COHHER i. Intelligi possunt arbores bitumin sæ et resinosæ, quales pinus et cedrus k. Al. quadratis i, scilicet ædisicium m lævigatis Vulg. i. e. dolatis ac politis ad aptiorem et sirmiorem campaginem n.

Schol. in ξύλων ασήπτω i. e. imputribilibus ..

II. Particulariter. Genus est ligni lævissimi et ad fluitandum aptissimi, et quod nunquam purescit P Vel 1. cedrus. Ita patres aliqui q et Ch. Fermissima enim erat, et inopia abietis ad classes usitata. Et in Syria frequens erat, et longissimas dat tabulas et incorruptibilis est. At cedri nomen EREZ tum Hebræis, tum Chaldæis, non GOPHER vel 2 Pinus u quæ nautica dicitur Virgilio quasi navibus aptissima. vel 3 Buxus w. At spississima hæc est et gravissima, nec fluitat in aquis x; vel 4. Abies una ex quatuor speciebus abietis z vel 5. cedrelate 2, quod accomodatius est Heb. voci quam cedrus b. vel 6, Terebinthus, Non tamen prorsus affirmo. Ea materie est lenta et sideli ad vetustatem, in Syria procera, quæ fola ungi velit, meliorque oleo fiat, et ejus baccæ funt sulphurosæ, sulphur autem Gophrithe dicitur. vel 7. Cupreffus d, tum ob firmitatem (nec teredines parit ut pote amara, hinc cupressinis tabulis inscribuntur duratura) tum ob similitudinem nominis. Nam quid aliud cupar vel cuper, Græcis etiam Κυπώρισσος quam Gopher. Nam mutationem G in C, PH in P, O in U nihil moror. Adde quod Crotenses ex cupresso et domorum trabes et naves struunt teste Pet. Mart. Legat. Bab. l. 2 p. 338. Et materie rarâ est, ait Plinius, ideoque aquis supernatat. Testatissimæ cupressi perpetuitati competit quod refert Epiphanius Hæres. lib. 1. p. 23. Arcæ reliquias ad suam ætatem visendas perdurasse. Et hinc arbor illa Diti sacra: et in arcas cupressinas mortuorum corpora condebant, quia in Diluvio erat, velut commune omnium hominum sepulchrum s, et dia rò aonaros ivas quia est expers putredinis, ait scholiastes ad lib. 2. Thucididis. Arborum maxime diuturna est cupressus, ex qua fabricatæ Ephefini templi valvæ per quatuor generationes incorruptæ durarant. Theophraft. Hist. Plant. 5. 5. et Plin. 16. 40. Opera ex cupresso permanent ad æternam diutunitatem Vitruv. 2. 9. perpeputè nunquam moritura cupressus Mart. Ep. 6.73. h. Vix tamen probat Fullerus hanc materiam ad navigia commodam &c. ait Bochartus. Qui ideirco illi succurrit et probat, et Plut. Sympos l. 1. prob. 2. Neque naupegus primo collocat-pinum-cupressum et Veget. 4. 34.

Ex cupresso et pinu—precipué liburna contexitur. Et cupressos ad naves struendas emi jubet Theodoricus Rex. Cassod. Var. 5. Epist. 16. Inter arbores raunnyois utiles cupressum nominat; Plato l. 4. Legum, et Diodorus l. 19. p. 702. His adde, quod in Assyria vel Babylonia (ubi primos homines habitasse constat ex Paradisi descriptione, et montibus Aratat, ubi arca substitit) nulla est alia materies unde fabricantur naves. Hinc classis ingens quam Babylone construxit Alexander constitit ex solo cupresso. Arrian in Alex. 1. 7. p. 161.

Strabo 1. 16. p. p. 741.

*He. in v. f Sic. But. g But. h Hi. D k Me. J S. m But. n Me. o D. p V. q Me, Ita. R. R. in M. et Ful, Onk. et Ion. D. V. Ful. Me. t Ful. misc. Q in. V. M. O. Ar. Ful. V. M. J T. o Ful. o Ca. d Ful. B P. o Ful. g Ful. g Ful ib. h B P. 1-4.

One might be inclined to call it alder, if the accounts of that tree mentioned below (r) be true. But although alder is faid to be very durable under ground, for a reason assigned by Scaliger; yet this tree is

The reason of giving this collection of opinions, concerning the wood of the Arc, is, that a fair argument may be drawn from all these almost united testimonies, that resinous kinds of timber did abound in the world before the flood. And whereas the strata of ligneous matter dug at 19 feet depth, under the surface of the earth, near Lough Neagh, and also under the water of the lake, are plainly formed by the deluge, of timber that grew before it. The reader is at liberty to choose, to which of all these resinous kinds, he will reduce this fossil wood: The reasons for the Inquirer's opinion, are given; but he reckons it fair dealing to lay every thing before his reader, which may inable him to judge otherways if he thinks proper: Yet still he thinks this comparison of testimonies confirms his opinion. For the distinction between cedar and cyprus, is not easily made with accuracy in these parts of the world, where there is very little of either to be seen in a state of growth, and not much in mechanical uses. There are two trees of the former kind, now growing in the physic garden in Chelsea; and the Bermudas is which did once abound with it, have, it is said very little of it at present: And cyprus is rather preserved amongst us in a shrubby form, to be used in medicine as savine, than in the form of forest trees.

(r) Ray fays of it in one book

Materies olim fabricandis naviculis inferviit.

Tunc almos primum fluvii sensere cavatas. Virg. Georg.

In ædificiorum fundamentis sub terrâ posita in solo humido permanet immortalis ad æternitatem, & sustinet immania pondera structuræ. Vide Vitruvium ubi agit de lignorum materie. Plin. l. 6. c. 37. Theophr. de causis lib. 3. c. 17. Cur alnus sub aqua non putrescat sed duret, rationem reddit Scaliger, humidum habet communis naturæ, non enim aquam sub aqua putresieri, quod nihil invehatur peregrini *. Venetiis magnis etiam sumptibus alnus accersiri solet ad facienda palatiorum et ædisciorum sundamenta: Palis etiam ex alno in terram adactis inædicsiatur pons ille samosissimus unius arcus de Rialto dictus, canali magno impositus, et duas partes urbis connectens

Raii historia plantarum de alno.

* Does not the water contained under the thin part of the hollow shell of an oyster, always grow fetid, that is, putrify, and is it not an art to open them without breaking that shell?

He fays of it in another book.

Certum est et indubitatum palos ex alno infixos progressu temporis lapidescere J. B. Verum, hoc neque alno propium, neque materiei ejus naturæ tribuendum censemus, sed potius conditioni soli, aut liquori cuidam lapidescenti qui in ejus poros se infinuat. Nam nec ipsam ligni substantiam in lapidem mutatam esse certum est, nec alno semper aut in quocunque solo accidit ut lapidescat, et alia præterea ligni genera in lapideam substantiam indurata vidimus, castaneam v. g. Aspleiæ non procul ab Woburn in Comit Bedfordiæ.

not usually found under ground in these places; tho' it be plenty in a growing state in the neighbourhood, and is found also in turf bogs not very far from hence. But although it were found under ground in plenty here, how shall the fragrant smell belonging to the petresied wood, be reconciled with the opinion of its being alder, which wants that smell: Some other wood should therefore be supposed*.

Although we suppose this petrefying wood, brought hither by the deluge, and lying in one place since that time, the smell may be preserved all that time, in such a situation: For a cedar chest of ninety years use in the open air, has preserved its power of exciting an agreeable smell (s); and that smell may be more easily preserved,

Experimentum Kentmanni de Alno in lapidem indurando nobis non successit *. V. C.G. in alno Cat. Plant. Angliæ J. Raii. Londini 1620. p. 14.

* L A P I D E S, e Ligno corporati.

Elatites ex abiete. Dryites, è quercu. Phegites, à fago. Clethrites, ex alno,

Hæc quidam præcedentia quatuor nomina imponi possunt, ut varietas sit nota. Iisdem interdum innascuntur sluores candidi, ut in illa arbore, quæ in vallibus Iochimi-

cis reperta est. Interdum Pyritæ flavi.

Ex alno etiam sit lapis artissciose hoc modo. Imponitur lignum, quantæ velis magnitudinis, in librà il'à amplà ænæà, in quibus lupulus coquitur, ad faciendam cerevisiam; cumque percoctus abundè lupulus est eximitur idem lignum, et arena vel glarea in ipsis celariis, obruitur per triennium; inde cum exemptum suerit, duratum in lapidem apparet: E quo potissimum cotes siunt, quibus ad ferramenta acuenda mensarii utuntur.

Rami, folia, cortices, ligna, carbones, offa, conchæ, quæ in faxa corporata sunt, succo lapidescente, in sonte non procul a Francosurto ad Viadrum.

Rami, folia, cortices, ligna manicæ chirothecæ, et alia, immissa piscinæ prope Schellenbergam arcem in Misnia, in saxa corporantur.

Trabes molares mutatæ in saxa: Quæ trabes prope Torgam in Albi sunt repertæ.

Ebenus subterraneus cum melanteria.

Lignum faginum in faxum corporatum, cujus dimidia pars adhuc lignum est.

Jo. Kentman Dresdensis medici Nomenclaturæ rerum sossilium, quæ in Misnia præcipue, et in aliis quoque regionibus inveniuntur.

De omni fossilium genere Conradus Gesnerus.
(s) The fossil trees are usually found without their roots, the trees and fruit are often found in the same earth at some distance, many of the trees are broken off near the root; these lie horizontally, and have many of their larger branches

in a place from whence predatory air is excluded. Fir preserves its refinous smell several centuries of years under ground, and why may not cedar and other kinds of woods, preserve their smells in the same manner. The gums and spices, which are vegetable productions, used in the preparation of mummies, preserve their smells in cloe catacombs, perhaps thousands of years.

If

Neagh,

also severed from them, and found at small distances; the extremities of the boughs are usually broken off, and where the roots lie in an irregular position, their extremities are usually broken off also: But these more frequently stand in their natural posture crest, and with their large roots running in their natural direction, down into the clay, or other sirmer bottom of the bog, and not unfrequently the stumps of these appear above the surface, the trunks lying at some small distances.

It is idle to imagine that these have been buried either at the creation, or the general deluge; at the sirst of those times, the strata must have been formed before trees were yet in being; and peat wood is far from being of Diluvian date, that much of it has been growing within these three or four hundred years, in the very places where it is now buried: In this state, that is, little altered from their natural condition, it is, that we principally find the fruits and larger parts of trees.

What we find of them more altered, are sometimes large and long branches of trees, sometimes shorter, sometimes small fragments of branches, and most frequently shapeless pieces of wood.

The larger and longer branches, are usually found bedded in the strata of stone, and these are usually more or less altered, into the nature of the stratum they lie in.

The shorter or smaller branches are found in vast variety, in the strata of blue clay, of which they make tiles in the neighbourhood of London; these usually carry the whole external resemblance of what they once were; but nothing of the inner structure, having all their pores so filled up with the matter of the vitrolic pyrites, as to seem pure masses of that matter; these fall to pieces on being exposed to a moist air, and are what are principally used for the making of green vitriol or copperas.

The irregular masses or fragments of wood, are principally of oak, and are found among gravel, and in many other strata; these are variously altered, by the infinuation of crystalline, and stony particles, but still preserving the veins of wood, they make a beautiful figure when polithed

These according to the various matter that has filled their pores, assume various colours, and appearances of various fossils that have filled them, some are perfectly white, and moderately hard, others of a brownish black, or perfectly black and much harder; others of of a reddish black, others are of a yellowish, and others greyish, and others of a ferrugineous colour: They are of different weights and hardnesses, according to the nature of the stony particles they contain. The most singular of these that I have met with, are two in my own possession, the one with its pores filled every where with a pure pellucid crystal, the other a black mass, which was simple oak within this hundred years, having been put as a prop to a roof of one of the mines in the Hartz forest, yet now is so perfectly petresied, as to strike fire with steel. This is much of the same kind with the samous fossil wood of Lough

If it be alledged that this smell, is the effect of the petrescent matter mixt with the wood. It may be answered, that if that was the case, the stony part of these mixt substances, would yield the strongest smell; but

Neagh, in Ireland, which the ingenious Mr. Simon has taken great pains to prove of recent petrification, and this a plain evidence of the possibility of that being the case. Mr. Simon has made many accurate experiments to prove this, and has favoured me with large quantities of the wood, some of which is wholly, some only a part petresied.

In the specimens I have from Germany, some have veins of sparry, some of earthy, and some of matter resembling that of the common pebbles; these sometimes, tho' rarely, have the shape of parts of branches of trees, they more usually look like broken pieces of

boards, and are generally found capable of a high polish.

Many substances have, it is certain, been preserved in the cabinets of the curious for petresied wood, which have very little right to that name: But where the sibrous and sissular texture of the striæ, and the vestiges of the Utriculi and Tracheæ or air vessels, are yet remaining, the bark yet perfect, and the several circles yet visible, which denoted the several years growth of the tree, none can deny such substances to be real fossil woods, and such as these are often covered with efflorences of spar or other minerals, and frequently contain veins of pure spar or crystal.

General natural History, by John Hill, p. 639.

This fort of wood is found most commonly in strata of gravel or sand, and sometimes in stone, clay, or marl; all that I observed of it was altered, and increased in hardness and weight, either by infinuations of stony and mineral matter, during the time that these and other bodies were sustained, among the dissolved stony and mineral matter, in the water of the deluge, by a total solution of the vegetable substance, and a succession of stony mine-

ral or metallic in its stead.

What hath been imagined by some, that this alteration was made since, by petrefying water, is without reason or any good observation to countenance it. Even that which is found in lakes, and in rivulets, was originally lodged in the earth at the bottom of them,

and petrefied before it was reposited there.

In particular, a more accurate inquiry and trials have been shewn, than what was formerly pretended of the petrefying power of Lough Oneagh, in Ireland, which is not true: For the water makes no such alteration upon any wood that is put into it. The petrefying wood that is brought thence, being of that which was originally lodged in the earth at the bottom of the lake. I instance in the wood brought out of this lake, because it is insisted upon, and more notice has been taken of it, than of any other.

The two foregoing quotations from Inquirers into natural phænomena, contain two opinions: I. The petrefied wood that is brought thence (from Lake Oneagh) being of that which was originally lodged in the earth, at the bottom of the Lake. And that this inquiry has been of an early date, appears from what he says afterwards.

II. Mr. Hill is of opinion, the petrefied wood of Lough Neagh of which he has many specimens, which were of the collection of the Author of this book, tho' sent by the Gentleman mentioned, is of a recent production, at least less than one hundred years. The Reader may give a judgment of these two opinions, from what is said in the course of these lectures.

it is quite otherwise, the stony part yields it faintly, the wood strongly, especially when it is burning, which shews that it is of the intimate nature of the wood, and can not be separated from it without a total destruction.

The manner of this timber being brought from other parts of the. world, to be interred here in the general deluge, is no difficulty to those who have any faith at all, or capacity to reason from general similar effects, to a common cause. Supposing therefore this heap of wood lying under strata of clay, to the depth of nineteen feet. This pressure continuing from the time of the deluge, through fo many centuries of years, produced a flattening of many of the trees, and thereby a close union of them, with the boughs also and leaves, which being broken off, are fqueezed together into hard folid cakes, that at first appear to be firm wood, and are forced in between the trunks fo as to make a stratum of a dense matter, without any visible interstice; for the wonderful effects of fuch pressure, have been already demonstrated, and it a sceptical perfon should alledge that an earthquake, which is capable of making prodigious changes in the furface and strata of the earth, might throw an heap of timber in this bed, he need only be told, that this part of the world has not ever been sensible of such dreadful phænomena, as the choques and tearing, and transplanting of these parts of the globe by earthquakes: But also he may be told, that the agitation of the waters in the deluge, might occasion such collision of the trees against each other. as not only to tear off their boughs, but even to split and break the furface of the trunks, so as to render them more closely united in one mass.

If it were proper to encourage this disposition in mankind, to form hypotheses upon all things, there is here a sair occasion to conjecture, that the origin of all jet and pit coal is wood; that is, strata of this kind of wood formed by the deluge, imbibing particular steams of the earth, become a most excellent and durable suel for sire. It would be going out of the way to inlarge upon this, and therefore the proper subject must be resumed *.

The question concerning the time necessary for petrification, should now be discussed.

As

^{*} Whoever will examine the whole collection of fossils, part of which is only published in this book, will see good foundation for this opinion, considering also the immense bodies of coal of various kinds, in the neighbourhood of these petrifications.

As to the time of petrification, we may take all or most of what has past since the general deluge. But if the whole time be taken, it may be asked, why is not the whole mass petresyed as well as particular parts. In answer to this it should be observed, that to produce any effect, there must be an aptitude in the subject matter, as well as the cause: Perhaps the pores of some of this wood, are too close to admit the petrescent effluvia of the earth, perhaps too wide to retain it; or, since the subtlety of effluvia is such sometimes, as to penetrate the most compact and dense matter, which is elsewhere mentioned in these lectures, it may be more consonant to true philosophy, to say, that there is a congruity between some pieces of wood, and this effluvia; and incongruity in respect to others: For there are many instances in the material world of this kind.

By congruity is here meant a proper proportion, as to bulk, shape, motion and pores, between any matter subtilized, producing phænomena along with other matter. Therefore it is possible, that as much of the petrification as is now effected, was made so very soon after the wood was deposited in the beds of petrification, and if it continue there some thousand years more, perhaps no alteration would be produced. This is proper to be observed, in compliance with the old and constant account, of the petrifications of this lake. If seven years, which is the general opinion at present, or three times seven, be the time for petrifications produced in the water of the lake; why should not the same cause produce its effects in the same time beyond the influence of the water?

It may be answered, that the water may help to produce this effect, sooner than the effluvia of the earth alone without it: For water has been already considered in this respect, and the same reasoning need not

be repeated.

These fossil petrifications may have been effected in seven years, twenty years, or a thousand, or more or less, than any of these for ought, any man can say, with soundation of reason; and yet the old testimony of the phænomena of petrifications in the lake, in a limited time may be true. For this testimony has almost every circumstance of credit to recommend it; its antiquity and universality are of weight in this respect, to which should be added, its not having any superstitious notions annext to it. For although these petrifications have been much admired, they were never worshipped;

worshipped; nor are they kept as venerable pieces of superstition, like the Cranbourn crystals mentioned already, which are preserved as religious charms, by those who live near the spring, where they are said to grow in one night's time: An opinion, universal and old, and without superstition, should not be despited.

The effluvia of the earth, therefore may produce petrifications in feven years, with the instrumentality of water; and upon a particular wood, holly, which was once very plenty about this lake, and much.

used by fishermen to fix their nets.

It is not easy now to get a specimen of holly converted to stone, with any wood continuous; because all this kind of timber is totally destroyed, and also because the fishing now practised, is not so much by fixt, as draught nets. At Toom being the common discharge of the lake, where fome thousand barrels of Eels are taken every year, there is occasion to drive a great number of piles, but none of these are holly, and tho' some are fixt twenty years, they are not any way petrefied: Yet a man who farms part of the fishery, and has been employed near thirty years, declares he put down one pile of holly on purpose to make an experiment, and that the lower part was turned to stone within feven years: He does not give his account as accurately, as a person conversant in philosophic matters would do, yet he is honest by character, and can certainly distinguish wood from stone. If experiments have been made to the same purpole, by others of undoubted reputation, which have failed, this should not explode the belief the fact*. For it is not easy to tell, how many concomitant circumstances are necessary, besides the principal cause, to wit, the terrestrial effluvia impregnated with stony particles; the holly perhaps ought to be of a certain age, or dimensions of growth; there is perhaps a particular depth of water required. There are perhaps particular places where the effluvia afcends freely, others where it is totally interrupted, by a stratum of dense compact matter; there may be a quiescence required in the water: But all parts of the lake are not convenient for that; the experiment may be tried in a place very proper in all these respects, and yet one storm may move the waters with fuch agitation, as to overwhelm that place with fand, and deteat the design of the inquiry, since no discovery can ever be made of the effect.

^{*} It should be remarked, that the Lough having increased greatly, perhaps within one century or two, experiments now made, are far from the places where these phænomena were common formerly.

effect. These are reasons why experiments may not succeed, and yet

the fact may be according to the old and universal tradition.

It may be urged, if terrestrial effluvia occasions these phænomena, and the production of them be so early as this reasoning implies: why are not specimens found in the land in greater plenty, and why have not some of those specimens wood continuous? The answer may be, that as many of them as lie near the surface of the earth, are subject to the influence of the external atmosphere, which is predatory, and destroys vegetable bodies, when the final period of vegetation is arrived at, that is, when the vegetable is come to its compleat condition of growth. The surface of the earth being often turned, they are liable to such collisions, as must separate the ligneous parts from the stone. For although specimens of this kind might have been very common, when these lands first admitted a plough, they may be scarce now. Ploughing in this place is not earlier than the reign of Queen Elizabeth. For Moryson (a) in his history observes, that they scarce knew what bread

(a) A Bohemian Baron complained, who having seen the Courts of England and Scotland, would needs out of his curiosity return through Ireland, in the heat of the rebellion, and having letters from the King of Scots, to the Irish Lords then in rebellion, first landed among them, in the furthest North, where for eight days space he found no bread, not so much as a cake of oats, till he came to sit with the Earl of Tir-Oen, and after obtaining the Lord Deputy's Pass to come into our army, related this their want of bread to us for a miracle, who nothing wondered thereat. Moryson's History of Ireland, Dub. Vol. 11. p.

To this authority it may be objected, that Ireland was once much more populous than

it was in the Earl of Tir-Oen's time, as the Archbishop of Dublin, King, relates. It is certain Ireland has been better inhabited than it is at present. Mountains that are now covered with bogs, have formerly been ploughed: For when you dig five or fix foot deep, you discover a proper soil for vegetables, and find it ploughed into ridges and furfrows. This is observed in the wild mountains between Ardmagh and Dundalk, where the redoubt is built, and likewise on the mountains of Altmore; the same as I am informed has been observed in the Country of Londonderry and Donnegal; a plough was found in a very deep bog in the latter, and a hedge with wattles standing, under a bog that was ' five or fix feet deep above it. I have feen the stump of a large tree in a bog ten feet deep, at Castle-Forbes; the trunk had been burnt, and some of the cynders and ashes lay still on the stump. I have seen likewise, large old oaks grow on land, that had the remains of 'ridges and furrows; And I am told that on the top of an high mountain in the north, there are yet remaining the streets and footsteps of a large town; and in truth there are few places, but either visible, or when the bog is removed, shew marks of the plough, which fare must prove that the Country was anciently well inhabited. It

Near

bread was in this part of the kingdom; although it might have been common to turn up surprizing specimens of these mixt substances, for some time after, yet now, after the frequent ploughing of the land, it may

be almost impossible.

The terrestrial effluvia considered as the cause of petrification, is thus cleared from the objections; and if it accounts for the turning of wood into stone, it may also easily account for the turning of wood into iron; for the internal air of the earth is as capable of bearing the particles of one as the other, since by propositions in the first lecture, all matter is capable of such comminution, as to be made to swim in a specifically lighter sluid. The internal air therefore, will always be impregnated with particles of such matter, as the strata have, which it pervades; but in the description of the lake, in Lecture IV. it was particularly remarked, that there was a great deal of iron ore on the shores of the lake, where it washes the County of Derry; and to that may be added, that strata of that ore reach to the mountain Slew Galen, and perhaps some distance under the lake.

It is likely that the Danes first, and then the English destroyed the people, and the old woods seem to those who pretend to judge, to be about three or four hundred years standing, which was near the time that Courcey and the British subdued the North of Ireland, and it is likely made havock of the people, that remained, after the Danes were beat out of Ireland. See manner of manuring lands, &c. in the Natural History of Ireland.

Although this remark may be allowed to be just, yet it does not prove, that the lands immediately incompassing the lough were ploughed. For having been extremely woody, a plough could not be used until they were cleared of wood, which it is well known was not done till within a century past: The high lands, or mountains, being formerly perhaps bare of wood, and the low lands overgrown, the former were ploughed by the very old inhabitants, the marks of which industry, may be discovered in some mountains. But when the low lands were cleared of two impediments, water and trees, the plough was used in them to better advantage; because they were more fertile.

Inducti terræ bonitate, volebant Pandere agros pingues & pascua reddere rura. Lucret. li. 5.

Inque magis dies in montem sucedere sylvas Cogebant, infraque locum concedere cultis,

The opinion which the ingenious and laborious Schuitzer mentions, tho' not with approbation, Iter alpinum, Lug. Bat. 1723 is probable and to the purpose. Orta est quæstio de prima vallium & montium inhabitatione—Prætendunt Montes, horumque apices initio suisse ab hominibus occupatos, quandoquidem nullum sit dubium, suisse inferiora montium latera, & valles ipsas montibus interiectas sylvas densas & horridas, quæ successu temporis & seculorum debuerunt a montivagis dejici, eradicari, & in prata virentia, agrosque sæcundos commutari, sensim adeo ad habitationem aptæ reddi.

Near the lake there is now an iron foundery, and the ore is principally raised between that and the mountain Slew Galen, which is within about ten miles of the lake. Here therefore is a stratum of metalline matter, to impregnate the terrestrial effluvia, and consequently in this place the pores of wood may be filled with this matter, as well as with that of stone. For the pores even of growing vegetables, admit metal-

line particles, which coalesce with the vegetable substance (b).

But if any one is surprized that the parts of matter, which are made so fmall, as to be boyed up by so light a fluid as air, can become such denle and weighty matter as iron and stone, let such a one consider. what extreme hardness air itself is capable of acquiring, even so as to become as hard as marble, if the particles are brought to contiguity; and experiments upon various forts of bodies, vegetable, calcarious, and metalline, prove that air intangled with other matter, help to constitute the natural bodies, as appears from the fixth proposition of the second Lecture, as well as those comminuted to a great degree help to constitute air. For air is in reality a fluid aggregate of exceeding small particles, of all forts of dense and heavy bodies; and may therefore be specifically heavier than any portion of comminuted matter, except gold, which is the heaviest; they may therefore all be allowed to be supported by the fluid air, except gold, by the known principles of Hydrostatics; and when the motion of the air is considered, which it always has more or less, comminuted gold may easily be allowed to float in it; for motion renders every kind of fluid capable of supporting bodies specifically heavier.

Thus are the three last questions answered, concerning these petrisications, as to the kind of wood, the time of petrisication, and the mix-

ture of metalline matter.

WE

⁽b) In monte Juntzen observantur ligna sagina aliis quæ alibi crescant duriora, graviora & varie intorta, nodosa, incolæ ipsi arcessunt hanc lignorum quasi serream duritiem, succo nutritio particulis ipsis Chalybis impregnato, & veluti serruminato, cui philosophus haud dissicilem præbebit assensum, si ligna norit per macerationes in aquis Chalybeatis Martiatis duriora reddi & serro pæne invicta. Constat præterea ex plantarum analysi vegetabilibus omnibus inesse particulas serreas quæ proin sucre ex terrà cum succo nutritio elevatæ: Elevabuntur autem plures, si terræ viscera venà serri sint reserta.

Schuitzer Iter Alpinum Lug. Bat. 1643. p. 160.

WE are now to speak concerning the medicinal quality of the Lake.

THE Sanative quality of the Lake, in respect to disorders in the surface of the body, not being fairly traced higher than the reign of King Charles II. there is not so old a testimony for this quality, as for its petrifications. The place most remarkable for this, is, a bay called Fisher's bay, in the County of Tir-Oen, as is related at large, Lecture IV. And perhaps the reason which gives that place the preference, is the smoothness of the shore, consisting of a soft sand, giving no pain to naked seet, together with an easy declivity which allows the timorous

to wade in, without any danger of a fudden plunge.

If the observations of some persons, who have bathed in that part of the lake, called Fisher's bay, be true, that the water or sand at the bottom in particular places, is warm, it is a probable argument, that there may be springs there. The Hungarian Governour, (de admirandis Hungariæ aquis) observes, that in the river Vagus near Galgotium, hot water rises in the bottom. Neque in ripà tantum eruuntur calidæ sed etiam intra amnem, si fundum ejus pedibus suffodias, calent autem immodicè &c. But this part of the lough having been frozen intirely, in the year 1739-40, destroys the probability of this; for it having been customary during the frost, to pass from one county to another, upon the surface of the frozen lake, passengers must have observed places unfrozen, if there were any; but the Inquirer never heard of such from any persons of credit.

Laying aside therefore the consideration of springs, if the water of the lake be not altogether of one homogene kind, at considerable distances from the mouths of the great rivers which form it, as partaking more or less of subterraneous effluvias, in different places: There is a presumption, that the water of that side of the lake where the iron (c) ore abounds, is the most sanative part of it; at least for some particular X 2

⁽c) As from what has been faid, it appears, that the subterraneal effluvia may cause distempers, so it may not be amiss to take notice, that possibly in some measure, mineral effluvia may prevent distempers. For it is observed, that several parts of Scotland are free from agues, and that very hot and large regions in the East Indies, are rarely troubled with the plague,

disorders. For suppose different strata of matter, to lie under different parts of the lake; the terrestrial essuair shall be impregnated in different parts of the lake, with different kinds of matter: In the County of Tir-Oen side of the lake, where there is a vast body of coal, it shall be impregnated with the bitumen, and other parts of coal (d); in the County of Derry side, where there is a great body of iron ore, the terrestrial essuair, must abound with sulphur, and such kinds of matter as constitute iron, which of all the metals is found to be most medicinal: And for this I produce the authority of a great chemist and physician. Boerhave says, bodies that owe their origin to the same earth, are easily

plague, nor is it less remarkable, that in Ireland, the air is impregnated with such fort of emanations, as prevent the generation of any venemous creatures; to which I shall add the following instance from Beguinus.

Dignum admiratione est, quod quamvis in vicinià Hydriæ comitatus Gloricensis, ubi reperitur copiosà &, singulis fere annis Lues pestifera grassatur, illa tamen semper immunis ab hac manere soleat, idque viri providæ ætatis se observasse, et a majoribus suis accepisse mihi

fancte confirmarunt. Boyle abridged by Boulton, Vol. II. p. 284.

(d) The beds of coal with which this Country abounds, in the neighbourhood of a navigable lake, which has also a navigable communication with the sea, by means of a canal, are of extraordinary consequence to the kingdom. The works are now in a fair way of answering the noble intention of the public, in laying out above fifty thousand pounds sterl. in order to open a free passage for supplies of fewel, to a great part of the kingdom, but especially to the capital of it. This passage (concerning which see the map) being a beautiful canal from the sea port of Newry, to the navigable part of the Ban River, being thirteen miles; and nine miles of the river, together with part of the lake, the Black Water river, and another canal from thence to the pits; will not only inable the kingdom to receive coals at eight or nine shillings a tun at distant places: But also the linen manufacture is hereby extremely benefitted, upon account of convenient water carriage for kelp, and all other weighty materials, necessary for that valuable branch of trade. But the design of this book being philosophical, rather than mercantile, a particular account of these things, may more properly belong to another treatife mentioned already. Yet one circumstance shall not be omitted, that whereas incessant rains during the summer of the year 1744, almost totally destroyed the fruits of the Northern parts of this kingdom, and the merchants were obliged to import, above one hundred and fifty thousand pounds worth of corn, for the support of the people, and the horses for want of food, were many of them dead, and the rest too weak for labour; this canal was of excellent use in contributing to convey the corn, to the inhabitants of five counties, in the neighbourhood of the lake: fo that moderately speaking, the lives of fifty thousand people were saved thereby, which is so great an emolument arising from this work, that not the original intention of it, that if no other should ever arise from it, the public is already amply rewarded for the expence: But it is also in a fair way of answering every intention of it, to which all imaginable success is wished. See 2 dialogue concerning some things of importance to Ireland, published this year in Dublin.

easily transmuted into one another: Iron which of all the metals seems to come nearest to the earth of animals and vegetables, must be al-

lowed likewise to come nearest to animals and vegetables in nature,

and seems as if it might in some measure be dissolved in them: And hence it yields a noble, and very safe remedy for diseases of the human

body, whilst the rest of the metals act with more violence (e).

The terrestrial effluvia abounding with the sulphur of the iron ore, is detained in the water, which thereby is rendered very fanative. If this detention of the effluvia, be thought to be faid without foundation, let it be considered, that in the common experiment of smoaking tobacco, if a contrivance be used to make the smoak pass through the water, that water shall become a strong emetic; this can be owing to nothing elfe, than the detention of the smoak in the body of the water: In the same manner may the terrestrial effluvia, be detained in the water of the lake, and that of different kinds, in different places. Hence may the waters be found more fanative in one place, than another, and fanative in respect to some particular disorders in one place, and in 1espect to other disorders in others. But the shores being very rough in some parts, and smooth in others; it is very likely the latter will always have the greatest reputation in this respect; people being apt to prefer those things, which are attended with least pain. To what has been laid down concerning these terrestrial effluvias, it may be objected, that if the water of the lake was impregnated with heterogene matter, in this manner; the chemical analysis of the water would discover it: But the analysis of this water, discovers nothing singular.

In answer to this, it should be considered, that the very nature of an effluvia, implies something very sugacious, and therefore not easily brought under the torture of chemistry, especially when experiments are tried upon the water, at the distance of the capital city from the lake;

being more than fixty Irish miles, from the nearest part.

It should also be considered, that the mixture even of metalline matter, when reduced to an effluvia, with water, does not necessarily increase the specifical weight, and for this the chemists might be quoted, particu-

⁽e) To this may be added, the sentiment of the ingenious James Keil. Tentamina medico physica 'ex dictis petenda est ratio cur ex Chalybe intensiorem, quam ex cæteris metallis, sanguis calorem concipit, quod scil, majori elasticitate donatur, quâ etiam ad vasa cobstructa aperienda gravioribus metallis præstat.

larly Mr. Boyle; if the propositions in the first lecture, concerning the prodigious increase of surface in the division of bodies, did not almost oblige us to infer it. For hence it follows, that metals comminuted so as to swim in sluids, must be reduced to such parts as contain under their surfaces, so little matter in respect to them, that whatever difference there may be, between their specific gravities and very light sluids, may easily be overcome by a gentle motion, or tenacity of the sluid; in which case there is an equilibrium, and that mixt sluid may be of the same specific weight, with the original homogene sluid. For this comminuted matter may be so small in quantity, as to mix with the sluid, and yet upon experiment not appear to add to the specific gravity, considering how many allowances must necessarily be made, for inaccuracy in most cases concerning natural phænomena (f). Mr. Boyle remarks some waters with mineral particles, are lighter than waters not impregnated with them upon account of volatility.

If the stony or metalline particles, be supposed to be still further divided, the surfaces are still larger than the proportion of the lessening matter, in which case they will swim on the top; and if after an agitatation of the sluid, which mixes them with it; a portion of the sluid be weighed, it may seem specifically lighter. If the particles are supposed larger, than the degree of smallness necessary to make them swim, they will sink, and if after agitation a portion of the sluid be weighed, it should appear specifically heavier.

In regard to the waters of the Lake, it may be difficult to fay which of all these may be the case: For if the terrestrial effluvia should bring stony and mineral particles with it, of equal gravity with water, they would continue in it, and a chemical analysis might determine something concerning them: If the particles were heavier, they would subside in all calms, when the water is almost quiescent, and form a very extraordinary sediment, capable of being observed; but since neither of these is the case, they are light and sugacious, and are perhaps constantly passing through the water into the upper atmosphere; which may also contri-

⁽f) I found by by weighing hydrostatically water impregnated with iron, that it was not much heavier than common water. Boyl on Gems, and in the same tract.

Sometimes mineral particles may be so spirituous, as not to increase their specific gravity; for I have seen ferrugineous water, which, tho strongly impregnated, was little heavier

^{&#}x27; than common water.'

bute to the wholsomness of the air. For whereas all fresh water (g) vapours are known to be more pernicious to human constitutions, than sea vapour, yet the air about this vast lake, is under no discredit in that respect (h). But whatever the case may be, it is sufficient at present, that the probability of a terrestrial effluyia is established, that the fact of petrisication is put beyond all doubt, that the place is accurately described, where more specimens may be had by suture Inquirers, to whom all success imaginable is wished.

As to the facts, as they now stand, and have been honestly laid before you, they can not by any suture inquiry be contradicted; for the facts can never be altered; you are at liberty, therefore Gentlemen, either to allow the reasoning upon them to be fair, or, at your leisure to substitute in the place of it, any other system which may seem more suitable to the subject.

⁽g) Yet the great Francis Bacon, says, (History of Life and Death) what seems strange, the salt marshes which are at certain seasons, overslowed with sea water, prove more unwholsom than the fresh.

⁽h) Qui corporis poros perpetuo permeat aer, multas necessario secum invehit aqueas particulas &c. Ja. Keil. Disquisitio secunda.

The air of Ireland being extremely moist, probably the intermixture of Chalybeate particles with it, in the neighbourhood of this lake, may prevent its ill effects.

Keil's remark upon bad air, is, Nullam non aeris mutationem corpora nostra afficere posser abunde patet, cumque minima naturæ corpuscula maxima virtute polleant, quo subtiliore e terra aut astris exhalatione aer inficiatur eò gravius nos plecti. But if this chalybeate effluvia be wholsom, the contrary effect must be produced. This seems to be the case of the air about Lough Neagh.

Advertisement.

I ERE should have followed a lecture concerning the present form of the earth, with the antediluvian, and paradisaical forms; This lecture is prepared, with a diagram, explaining many things concerning the Deluge. For in as much as the beds of petrifications, which make a great part of the subject of this book, are proved to be formed in the change of things, in the great Æra of natural appearances, the general flood in the time of Noah, a fair account of the effects of that inundation, would properly belong to this place. But it is too large for infertion, and were it not so, the Readers being of the class of the FAITH-FUL in religion, as well as the skilful in philosophy, it is hoped, that it will not be deemed necessary.



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APPENDIX

CONCERNING THE

EFFLUX and INFLUX,

OF THE

WATER

OF

LOUGHNEAGH.

HE papers in the philosophical transactions, copies of which are given below (i), (k) such kinds of computations not being easily retained in the memory, are the soundation of the sollowing account of Lough Neagh.

Y

(i) An experiment of the evaporation of water, by Mr. Edm. Halley, n. 189. 366. Lowthorp's Abridgment of the Philosophical Transactions, Vol. 11. p. 108.

We took a pan of water (salted to the same degree as is common for sea water, by the solution of about a fortieth part of salt) about sour inches deep, and seven inches, nine tenths diameter, in which we placed a Thermometer, and by means of a pan of coals, we brought the water to the same degree of heat, which is observed to be that of the air in our hottest summers; the Thermometer nicely shewing it. This done, we affixed the pan of water, with the Thermometer in it, to one end of the beam of the scales, and exactly counterpoised it with weights in the other scale, and by the application or removal of the pan of coals, we found it very easy to maintain the water in the same degree of heat precisely.

Doing

They who have surveyed this Lake, observe, that there is only one visible discharge of the water of the lake at Toom, and that there are eight pretty considerable rivers besides rivulets, constantly conveying water into it: And that the discharge seems vastly disproportionate and inferior in quantity, to the sum of the inlets. Hence some have been induced.

Doing thus we found the weight of the water fensibly to decrease, and at the end of two hours we observed, that there wanted half an ounce troy, all but seven grains, or two hundred and thirty three grains of water, which in that time had gone off in vapour; tho' one could hardly perceive it smoak, and the water was not sensibly warm. This quantity in so short a time seemed considerable, being little less than six ounces in twenty four hours, from so small a surface as a circle of eight inches diameter. To reduce this experiment to an exact calculus, and determine the thickness of the skin of water that had evaporated, I assume the experiment alledged by Doctor Edward Bernard, to have been made in the Oxford Society, viz. that the cube foot English of water, weighs exactly seventy six pounds troy: This divided by 1728, the number of inches in a foot will give $253\frac{1}{3}$ grains, or half ounce $13\frac{1}{3}$ grains for the weight of a cube inch of water. Now the area of the circle, whose diameter is $71\frac{1}{9}$ inches, is 49 foot square inches, by which dividing the quantity of water evaporated viz. $\frac{35}{38}$ of an inch, the quote $\frac{15}{102}$ or $\frac{1}{35}$, shews that the thickness of the water, evaporated, was the 53d part of an inch: But we will suppose it only the 60th part, for the facility of calculation.

To estimate the quantity of water arising in vapour out of the sea; I think I ought to confider it only for the time the sup, for that the dews return at night, if not more vapours, than are then emitted: And in summer the days being longer than twelve hours, this excess is balanced by the weaker action of the sun, especially when rising before the water be warmed: So that if I allow $\frac{1}{16}$ of an inch of the surface of the sea, to be raised per diem

in vapours, it may not be an improbable conjecture.

Upon this supposition, every to square inches of the surface of the water, yields in vapour per diem, a cube inch of water; and each square foot, half a wine pint; every space of 4 seet square, a gallon; a mile square 60 r4 tuns; and if the Mediterranean be estimated at 40 degrees long, and 4 broad, allowances being made for the places where it is broader, by those where it is narrower, (and I am sure I guess at the least) there will be 160 square degrees of sea; and consequently the whole Mediterranean must lose in vapour, in a summer's day, at least 5280 millions of tuns. And this quantity of vapour, tho' very great, is as little as can be concluded from the experiment produced: And yet there remains another cause which can not be reduced to the rule, I mean the winds, whereby the surface of the water is licked up, somewhat safter than it exhales by the heat of the sun, being well known to those that have considered those drying winds which blow sometimes.

The Mediterranean receives these considerable rivers; the Iberus, the Rhone, the Tiber, the Po, the Danube, the Neister, the Boristthenes, the Tanais, and the Nile, all the rest being of no great note, and their quantity of water inconsiderable. We will suppose each of these nine rivers, to bring down ten times as much water as the river Thames, not that

duced to suppose a subterraneous passage, to account for the discharge of a surplus mass of water, which otherwise should rise to a very considerable height. But in as much as there appears not any sign of such passage to navigators upon the lake, and which could not be concealed from them, (was there any such thing) the influx of water at such a passage.

any of them is fo great in reality, but to comprehend with them all the small rivulets that

fall into the sea, which otherwise I know not how to allow for.

To calculate the water of the Thames, I assume that at Kingston's bridge, where the stood never reaches, and the water always runs down; the breadth of the channel is 100 yards, and its depth 3, it being reduced to an equality (in both which suppositions, I am sure I take the most.) Hence the Profile of the water in this place, is 300 square yards: This multiplied by 48 miles (which I allow the water to run in 24 hours, at 2 miles an hour, or 84480 yards, gives 25344000 cubic yards of water to be evacuated every day, that is, 20300000 tuns per diem: And I doubt not but in the excess of my measures of the channel of the river: I have more than sufficient allowance for the waters of the Brent, the Wandel, the Lea, and Darwent, which are all worth notice, that fall into the Thames below Kingston.

(k) The evaporation of water in a close room at Gresham College 1693, by Mr. Edm. Halley, n. 212. p. 183. in the Abridgment of Phil. Trans. by Lowthorp. Vol. II. p. 110.

In order to explain the circulation of vapours experimentally, I caused an experiment of the quantity of vapours arising simply from the warmth of the water, without being exposed either to sun or wind, to be made in Gresham College, which was performed with great care and accuracy, by Mr. Hunt operator to the Royal Society. Having added into one sum the evaporations of the whole year, I find, that from a surface as near as could be measured of eight square inches, there did evaporate during the year 16292 grains of water, which is 64 cubic inches of water, and that divided by 8 inches, the area of the water's surface, shews that the depth of water evaporated in one year, amounts to 8 inches. But this is much too little to answer to the experiments of the French, who found that it rained 19 inches water in a year at Paris; or those of Mr. Townley, who by a long continued series of observations, has sufficiently proved, that in Lancashire at the foot of the hills, there falls above 40 inches of water in the year's time. Whence it is very obvious, that the sum and wind are much more the causes of evaporation, than any internal heat or agitation of the water.

The same observations do likewise shew an odd quality in the vapours of water, which is that of adhering to the surface that exhaled them, which they cloath as it were with a sleece of vaporous air, which once investing it, the vapour rises afterwards in much less quantity: Which was shewed by the small quantity of water, that was lost in 24 hours time, when the air was very still, in proportion to what went away in a strong gale, although the experiments were made in a place, as close from the wind as could be well contrived. For which reason had wind come freely, it would have carried at least three times as much as we found, without the assistance of the sun, which might perhaps

have doubled it.

a passage in a lake every where shallow, necessarily occasioning a whirspool dangerous to navigation; it seems reasonable to account for the height of the water, not ordinarily exceeding a particular known alti-

tude, in the following manner.

Before the autumnal season of the year, when the rains begin to soften the earth, and swell the rivers, the water discharged at Toom, is very inconsiderable, so as not to afford a depth greater than that, which may reach to a shoe buckle, or the knee of a person wading; and once it happened, that a person taking the opportunity of an in-blowing wind, walked over dry shod (a). But at the same time the influx of water is inconsiderable.

The upper Ban, which may be supposed the greatest of the eight rivers, for it eminently gives a name to all the rest, when they slow in one channel to the sea, being called the lower Ban, has been frequently observed to have scarce any current water in it, immediately before the salling of the great rains; and upon this account is not reckoned by some writers, amongst the rivers of Ireland, but is considered as a large brook: The definition of a brook being, a water slowing in a known channel, in the form of a flood, owing to a sudden sall of rain in the neighbouring mountains, whence it takes its rise. The Bleachers upon

By the same experiment it likewise appears, that the evaporations made in May, June, July, and August, (which are nearly equal) are about three times as much as what evaporated in the 4 months of November, December, January and February, which are likewise

nearly equal, March and April answering nearly to September and October.

The fleece of vapours in still weather hanging on the surface of the water, is the occasion of very strange appearances, by the refraction of the said vapours differing from the common air, whereby every thing appears raised, as houses like steeples, ships as on land above the water, and the land raised, and as it were listed from the sea, and many times seeming to overhang.

And this may give a tolerable account of what I have heard, of seeing the cattle in the Isle of Dogs, at high water time from Greenwich, when none are to be seen at low water, (which some have endeavoured to explain, by supposing the Isle of Dogs to have been listed

by the tide coming under it:)

But the vaporous effluvia of water, having a greater degree of refraction, than the common air, may suffice to bring these beams down to the eye, which when the water is retired, and the vapours subsided with it, passes and consequently the objects seen at the one time,

may be conceived to disappear at the other.

(a) This is a broad bank near the Eel waers, over which when the water has passed, it. slows in a much narrower channel, being five and twenty feet deep in part of it, and flowing with rapidity. The channel contains two eel waers, one of which is rendered useless, by a great quantity of fand thrown into it by the water in storms.

this brook, for such it may be called, although it be a considerable flux of water a great part of the year, are well acquainted with the phænomena of it, and do frequently in a fair sun-shining day, hear the roaring of a torrent at a mile's distance, the mischief of which they can not always prevent, but must sometimes suffer the damage of having sifty pieces of linen washed off the green, which, although often found, being stopt by rocks and bushes, are often torn. The course of this brook from the fountain head in the mountains near Rathfryland, to the lough in a direct line, is not above four or five and twenty miles; and showers in mountains being frequent, when there is no appearance of them in the vallies, most rivers or brooks whose courses are short, upon this account are subject to torrents. The Poet says,

Rusticus expectat dum defluat amnis, at ille Labitur & labetur in omne volubilis œvum.

Rusticus here does not signify what is vulgarly thought a countryman or peasant in general, but particularly a mountaineer, who being well acquainted with the nature of torrents in the mountains, which may rise and fall, in less than the space of an hour, thinks when he descends to the vallies, and seeing a regular flowing river, that it is of the same nature of a montaneous torrent, and that in a little time he may walk over dry. But in this he is deceived; For labetur in omne woum.

At the conclusion therefore of the summer, supposing it a dry season, there is very little water slowing into the lough, since the other seven brooks, or rivers are singly inferior to the Ban in quantity of water. When the rains fall in abundance, and the brooks or rivers swell above their banks, and continue so during sive months, and sometimes more, there is a prodigious quantity of water, in so much that the discharge at Toom being vastly less, the water of the lough usually rises from six to nine feet perpendicularly, and spreads over about ten thousand acres of land, more than it does when it is at the lowest, which is about 100000 acres. In the spring of the year when the eight rivers are reduced to rivulets, by the drying winds in March and May; the influx of water is much less than the efflux; the discharge at Toom is all that

time

flat grounds about it becoming useful for bleaching, pasture, and meadow.

The discharge of this great body of water, may be estimated in

the following manner.

The lake is about 60 miles round, which may be reduced to the form of a square of fifteen miles a side, for the take of computation, although being nearly circular, it does in that form contain a much larger area of furface, than in the lame number of miles in a square from a known property of the circle, being the molt capacious of figures: Multiply 1760 yards in an English mile, by 15 the side of the square, and then that product into itself, and you have 696960000 iquare yards in the surface of the lake, and supposing the lake to be at a medium six feet deep all through, computing the height of the water from the furface, when it is lowest in summer, to the surface when it is highest in winter, although the difference for the most part is much greater, except on the lands which are only flooded in winter: Yet at a medium supposing the increased height six feet, or two yards all over, and multiplying the number of superficial square yards by 2, you have 1393920000 cubic yards of water; and supposing the channel at Toom, the common visible discharge of all the water out of the lough, to be only 100 yards broad, and its depth three yards, it being reduced to an equality, although in the deepest part it be five and twenty feet (a), hence the profile of water in this place is 300 square yards. This multiplied by 48 miles (or 84480 yards) which the water may be allowed to run in 24 hours at 2 miles in an hour, gives 25344000 cubic yards of water discharged in 04 hours, which dividing 139392000, the cubic yards of water expressing the whole mass of increase in the winter, you have a quotient of 55 exactly, expressing the number of days in which the whole mass of additional water, may be discharged; provided there was no influx at the same time; but there is a very considerable one at the beginning of the computation, and it lessens afterwards, till at last in the driest time of the year, it becomes very little: The discharge of this influx of water may be accounted for another way, being carried up in vapour, and may be computed in the following manner. That

That one tenth of an inch of the water of the lake, is raised per diem in vapours, may not be an improbable conjecture from the conditions

mentioned in the foregoing paper.

Upon this supposition every 10 square inches of the surface of the water, yield in vapour per diem a cubic inch of water, every space of 4 feet square a gallon, and a mile square 6914 tuns. And if the lake be estimated as above, as a square whose side is 15 miles, there will be 125 square miles of water, which multiplying 6914 gives a product 864250 tuns of water, raifed daily in vapour during the drying months. This may reasonably be supposed, to be a ballance for the influx of eight rivers into the lake, which being subject to montaneous floods are not at other times very abundant in water. It should be considered also, that the discharge at Toom, upon account of in blowing, or out blowing winds, may flow with a different degree of rapidity and depth of water: For it has happened twice in one century, that the river Rhone at Geneva, where it passes from the lake of that name, has been stopped by a storm, where its usual depth was five and twenty feet, in so much that people went down into its channel, and took up fish, medals and other things.

Lough Neagh is often interrupted or accelarated in its course, in a manner similar to this; besides, it sometimes rolls the gravel and throws up a barrier against itself, choaking its own channel, and sooner or later another wind perhaps removes that (a). Hence it happens, that the times of the lakes highest and lowest waters, can not precisely be brought to rules: For they happen looner or later in the year, according to the agency of all these causes, especially since the causes which raise these vapours from the lake, do also at the same time diminish the rivers during part of the spring and summer (b): And in the beginning of the

computation

(a) In the narrow channel where the profile of water is computed page 156. There are two eel waers, one of which is rendered useless by a great quantity of sand, which was thrown in by the water in a storm, making it too shallow; for the fish run in deep water.

(b) If any exceptions are taken to this reasoning upon a fresh water lake, drawn from that already applied to a falt sea; it should be observed, that the difference in weight between falt water and fresh, is not considerable, and that the sun exhales little or

The Inquirer has observed at the Giant's Causey, in the North of Ireland, where the fea at high water wathes the tops of the pillars, the fun did evaporate the water, between tide and tide in a hot day, and left in the top of each concave pillar about a small spoonful of good salt. Hence should be inferred, that little or no salt is exhaled by the fun from the lea.

computation when the rivers are full, the lake has by ten thousand acres a larger furface for the fun and winds to act upon, and confequently does then really yield a greater quantity of vapours cæteris paribus. If any person knowing the course of the waters of the lake, should observe. that at the high rock called the fall at Colerain, which is the only pasfage for the waters of the lake to the sea, there be an appearance in the dry months, of much le's water, than passes at Toom, being the beginning of the channel wherein the water is conveyed to the sea; let it be considered, that about a mile from Toom, the water spreads again into a small lake of about four miles diameter, as may be seen in some of the maps prefixt to Lecture IV. particularly that of Speed, from which a great quantity of vapour must arise, and diminish the quantity of water that otherwife would flow to Colerain; add to this the course of the water for twenty miles, before it reaches the fall of Colerain, during which space of motion the winds and sun continue to diminish it.

Mr. Boyl indeed fays, I have observed, that even the lightest waters will yield a small

quantity of common salt. Boyl abridged by Boulton, Vol. I. p. 296.

N. B. The Inquirer having made remarks upon the wind, weather and barometer, for a year and a half, in Lurgan, near Lough Neagh, having fixt a weather vane upon a steeple for that purpose, to observe the direction of the wind, and another on his house, to denote the force by means of that and some machinery within; and having noted down the remarks for every day in diffinct columns, he thought to have inferted them here; but the Barometer and one weather vane meeting with accidents, which hindered him to compleat two years observations as he intended; (those of the time mentioned not being sufficient for his design,) he chules instead of publishing his own imperfect observations, to lay before the reader a specimen, of what may be done this way, in imitation of the Gentlemen at Edinburgh, amongst whom there seems to be a spirit for promoting natural knowledge. If such observations were made with accuracy, in feveral parts of this kingdom, many useful things would attend the knowledge thence redounding. The form of the tables for this purspose, used by them and the Inquirer, tho not exactly the same, might in a great measure answer the same purpose.

Meteorological Register.

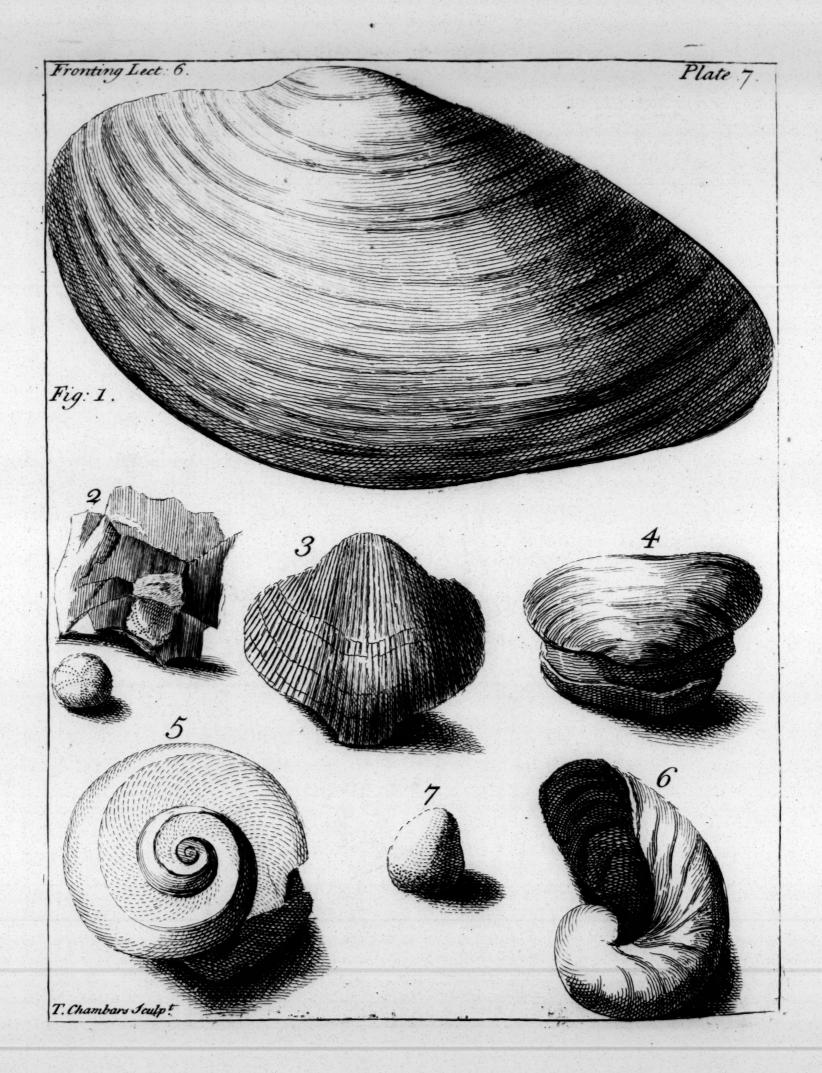
January.									
		Hour	Barom.	Therm.	Wind	Weather	Quantity of rain.		
Day 1	a. m.	p. m.	In Day	In Day	Direction Force	In Day	Day and Night		
1	10	4	29	8 7	S. W. o	Cloudy			
2	9	6	27	8 6	S. E. 2	1	Day and Night		

Ours fall short of the plan of these Gentlemen, in as much as they had a column for the

Hygroscope. See Medical Essays, Edinburgh, Vol. I MDCCXLVII.

Such registers for every County in the kingdom, and for different parts of the same County, where there are mountains or lakes would be extremely useful, with regard to health, gardening, farming, &c.—besides many things of information to philosophers and speculatilts.





GEMS:

OR, THE

Physico-Mechanical Lecture:

BEING THE

PRODUCTIONS of LOUGH NEAGH,
Of the more precious Kind,

Applied to Use by

MECHANIC ARTS.

TOGETHER WITH

The PHYSICAL CAUSE of GEMS.

LECTURE VI.

Exod. xxviii.

And they shall make the Ephop—And thou shalt take two Onix stones, and grave on them the names of the children of Israel. And thou shalt make the Breast-plate of Judgment—and thou shalt set it in settings of stones—the first row shall be a Sardius, a Topas, and a Carbuncle: And the second row shall be an Emerald, a Sapphire, and a Diamond: And the third row a Ligure, an Agate, and an Amethyst: And the fourth row, a Beryl, and an Onyx, and a Jasper: They shall be set in Gold in their inclosings.

 AN

ADDRESS

TOTHE

LADIES.

LADIES,

AVING acknowledged the favour of the Gentlemen in a former meeting, a prefatory address is justly due to you in this. It is with pleasure the Philosopher speaks, when the Ladies are to approve. And what should he speak but praise, when the works of Nature, which may always teach, and can never corrupt, are deemed by you not unworthy of your study? The Emerald and Topaz are not died in vain, when they improve your minds, as well as adorn your bodies.

Beauty is to you, what gold is to the Diamond or Ruby in the Jewel, only the fetting; and if a little art is bestowed to render that setting not unsuitable to its place, it is not that alone which engages the Curious.

Knowledge does as well become one sex as the other, and if by a kind of Turkish policy, it be concealed from yours, that is a misfortune. Yet such a disposition as by this day's meeting you shew, must upon many occasions have opened your minds to information, which renders you truly valuable in that, for which you ought principally to value yourselves.

They who have travelled latest into foreign parts can assure you, that a lady of Bologna has advanced so far in the study of natural pha-Z 2 nomena,

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nomena, as to deliver Lectures upon them, in the elegance of the Roman language, hitherto thought the province of men +.

But since your humility will not let you take upon you the office of teachers, your judgment directs you to do the next kind things, to hear, and to approve.

Your patience therefore is humbly defired in one, with hopes of ob-

taining favour in the other.

THUS much was faid upon the occasion of reading the Lectures in manuscript, one of which many Ladies attended, having earnestly requested to be admitted, and were those of rank and judgment; and who were pleased to express their approbation of the information they received.

The Inquirer is of opinion, that he said no more in this Address than what was civil and just; but in as much as he has been called upon, either to retract or defend his sentiments of the Ladies in the circumstance of Literature; he chuses rather to defend his opinion than to give up the honour of any part of the human race, and in reality the great interest of the whole.

The foundation of his opinion, that Women should be taught, and made in a better degree acquainted with Arts and Sciences than is customary, shall be expressed in few words. It is plain that Women have the management of the male part of the species as well as the semale, for the sew years of the beginning of life: It is well known that the impressions made upon the human mind, even in the first years, are of considerable importance to the welfare of the human race: It is also well known that by the death of husbands, Women often get the government

† This Lady has taken a Doctor's degree in the university, and is called Doctor Teresa: She is married and is a mother of children. To this may be added an account lately sent from Stockholm. The Countess Senatrix of Ekeblad, was declared a member of the Royal Society, for the encouragement of Arts and Sciences, in consideration of the many valuable experiments, that Lady has made in the art of Occonomy.—The Prince has granted her his royal patent for the publication of those experiments. To these accounts may be added a more recent sact. By a letter from Milan we are informed, that Madam Catane Agnesi, native of that city, celebrated for her prosound learning and knowledge in several Arts and Sciences, particularly in the Mathematics, had been some time since named to fill a vacant Prosessorial This Lady has since wrote to the Pope, to thank him for the honour he has done her, for having made choice of her to fill that place; to which his Holiness answered: 'That this was not only an honour to her, but much more to the University, which has the glory to possess a Lady, who by her prosound learning surpasses all those of her time.'

of large families of children, and that the opinion of the Mother must in a great measure determine their course of Education. To ask, after being thoroughly sensible of these things, whether it is proper to give more knowledge to the Female part of human fociety? is to ask a que-Ition too idle for a studied answer: But it may be asked in return, whether Solomon's description of a good Woman be a mere religious Ens Rationis, or a description of what may and should often come to pass? If it be the latter, it will not be easy to reconcile all that skill of manufactures and prudence of behaviour, with the opinion of those perfons to whom this Reply is addrest. "Who can find a virtuous Wo-" man: for her price is far above RUBIES. The heart of her Husband "doth fafely trust her, so that he shall have no need of spoyl. She " will do him good and not evil all the days of her life. She seeketh " wool and flax, and worketh willingly with her hands. She is like " the merchants ships, she bringeth her food from afar. She riseth " also while it is yet night, and giveth meat to her houshold, and a " portion to her maidens She considereth a field and buyeth it: with " the fruit of her hands she planteth a vineyard. She giveth her loyns " with strength and strengtheneth her arms. She perceiveth that her " merchandize is good; her candle goeth not out by night. She layeth " her hands to the spindle, and her hands hold the distaff. She stretch-" eth out her hand to the poor, yea she reacheth forth her hand to the " needy. She is not afraid of the snow for her houshold: for all her " houshold are clothed with scarlet. She maketh herself coverings of "tapestry, her clothing is filk and purple. Her husband is known in "the gates (a), when he sitteth with the elders of the land. She ma-" keth fine linen and felleth it, and delivereth girdles unto the mer-" chant. Strength and honour are her clothing, and she shall rejoyce " in time to come. SHE OPENETH HER MOUTH WITH WISDOM, " AND IN HER TONGUE IS THE LAW OF KINDNESS. She looketh " well to the ways of her houshold, and eateth not the bread of idle-" ness. Her children arise up and call her blessed; her husband also

⁽a) The Courts of judicature were held in the Gates of cities: the making and execution of Laws with judgment and integrity, is the most honourable office in a civil state; and the approbation of conduct upon a fair scrutiny before upright Judges is the highest praise.

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" and he praiseth her. Many daughters have done virtuously, and thou " excellest them all. Favour is deceitful and beauty is vain; but a

"Woman that feareth the Lord, she shall be praised. Give her of the fruit of her hands, and let her own works praise her in the gates."

This charming character is founded upon a great degree of useful knowledge; and if the subject of the following Lecture be not express in it, perhaps it is not excluded from it. Although Solomon does not recommend the study of this part of Natural Philosophy, concerning Gems, to Women; yet he chuses them as precious parts of Natural Productions, to which to compare a valuable Woman; Her price is far above Rubies.

There is no occasion to dispute critically here, which of the Gems he really means: For it is not any one kind of Gem, but a substitution of a less for a more general kind; and the meaning is all kinds of Gems held in estimation by mankind: If they were not worth the contemplation of Women, they would not be worth a choice in Solomon's judgment upon which to found a comparison in so extraordinary a case; especially since God also made choice of them for civil and religious purposes.



LECTURE

LECTURE VI.

THE indisposition to believe things creditable of *Ireland* shall be a sufficient reason for caution, in all that shall be laid before the Reader, in regard to GEMS: And previous to every thing upon this subject, the Inquirer declares honestly, that the specimens which he shall hereafter mention, were not brought to the capital of this kingdom upon any opinion of their being valuable in any other respect, than that of slints and pebbles (a); except the Crystals, whose natural transparency,

(a) A late writer's remark upon those who have hitherto treated this subject, shall be a reason for caution not to borrow any thing without an acknowledgment.

"The Lithologists are, indeed, of all Authors, the greatest Plagiaries: Every one who has read them, will find that reading one of them is much the same thing with reading them all; and that, in a subject where personal discoveries went but a little way, they have all adopted not only one another's sentiments and opinions, but their words and sentences; Examples for which, even for whole pages together, are but too frequent with many of them; and that without the least hint at the name of the Author, or that they were from any where else. Hill his General Natural History, page 500. What follows from the Scriptures and the Bishop of Ely, is to shew, that Gems have been in high estimation, and that God himself highly regarded this part of his own workmanship, confecrating them to religious purposes; and also, that it is extremely difficult to determine what Natural Appearances belong to the ancient names. Con-

cerning the precious stones mentioned in the title page of this Lecture, Fagius writes,

"Est tanta etiam de nominibus istorum lapidum apud omnes interpretes cum nostros

tum Hebræos discrepantia ut nemo sere quid certi statuere potest."

Crit. Sacri.

The Septuagint verosin, according to the Alexandrian manuscript, gives the Greek names of these stones, as follows, Σάρδιον κὸ τοπάζιον, κὸ σμάραγδω, ὁ τίχω ὁ τίτας κὸ ἀμάθυςω. Καὶ ὁ τίχω ὁ τέτας κὸ ἀμάθυςω. Καὶ ὁ τίχω ὁ τέτας κὸ ἀμάθυςω. Καὶ ὁ τίχω ὁ τέτας κὸ, χρυσόλιθω κὸ βερύλλιον κὸ ὀνύχιον.

The

parency, figure and beauty inclined him to think favourably of them, that the improvement of Art would render them more estimable. Several

The Hebrew text with Montanus his translation is as follows,

置 (Odem	Rubinus	Lefchem	Ligurius
Odem Pitdah Bareketh	Smaragdus	Schebo	Achates
Bareketh	Chryfolitus	O Achlama	Amethysus
्रञ्च (Nophech	Carbunculus	Tharschisch	Tharfis
Saphir	Sappirus	Tharfchifch Scholam	Onyx
Saphir Iahalom	Adamas	Jaspeh	Jaspis

The first row shall be a Sardius, &c.] There is so little certainty what these stones were, that nothing can be affirmed about them; as appears by the vast variety of interpretations, that have been made of them, by writers both old and new: The first of them is called Odem in the Hebrew, which some take to be a Ruby, having no other reason for it, but because it signifies red. Others take it for an Adamant; which may seem to be derived from Odem, as a Jaspri is from Jasphe. And there are several other conjectures, but none so probable as that of our Translators, who call it a Sardius, or Sardine stone, as they render it, (iv. Rev. 3.) which is of a red slaming colour, as Braunius hath demonstrated from several Authors (Lib. 11. de vest. facr. Hebr. c 8.-n. 8.). But as some describe it, with a cast of yellow in it like that of fresh oyl. And it is not improbable that this stone had the name of Sardius from the Hebrew word Sered, which signifies red, xliv Isa. 13. as Kimchi there interprets it. And thence the divine majesty is said to look like a Sardine stone (in the place above named) because he appeared in great anger. So an ancient writer, Διὰ τὸ φοδεερὸ, πυροειδες γὰρ τὸ σάρδιος.

A Topaz.] The fecond stone in this row, is in Hebrew called Pitdah, which we truly translate a Topaz: which was a stone of a green colour, not a yellow, as we now commonly understand it. So Pliny and others, as the same Braunius shews, L. 11. c. 9. where he fancies that the word Topasion, by an easy change of letters, was made out of Pitdah: for the Syriack interpreter xxi Rev. 20. calls this stone Topadion; in which there are the same letters that are in Pitdah: but however this be, it appears from xxviii Job 19. that this is the right translation of the word; for there it is Pitdah Cush, the most excellent Topaz stones, being sound in an island belonging to Arabia, called thence by the name of Topazion.

And a Carbuncle.] So we translate the third stone of the first row (which in Hebrew is called Bareketh) following perhaps Abarbinel. But the greatest part of interpreters take it for the Smaragdus: which good authors describe as the most radiant of all other stones; and therefore called perhaps Bareketh, from its extraordinary splendor. For Barak, eve-

ral of them being put into the hands of Lapidaries, Seal-cutters and Jewellers, particularly Messieurs Standish, Billing, and Nichols; and the Inquirer

ry body knows, signifies to glitter, xxi Ezek. 10. The best authors say, the colour of it is a grass green; wonderfully refreshing (as Pliny describes it) to the eyes when one

looks upon it.

Ver. 18. And the second row shall be an Emerald.] The Hebrew word Nophech, which we translate Emerald, is by most interpreters taken to signify a Carbuncle, some of which stones are white; but the most excellent of all others are red, shining like sire, or a burning coal: whence the name of Carbuncle, from Carbo a hot coal, and to this the Hebrew word Nophech agrees; which Braunius ingeniously conjectures comes from Phuch, which signifies that red wherewith women painted their faces, 2 Kings ix. 30. and, in short, he takes it for that stone which now we call a Ruby. And so Abarbinel translates it, and Luther also; vid. L. 11. c. 11.

A Saphire.] This stone is mentioned before xxiv. 9. and it retains its name to this day, almost among all people. So that there is no question, but only what kind of stone it was about which Authors differ. For some say it was a white stone (and there are some so pale that they incline rather to that than any other colour) but it is plain, that stone was called anciently a Saphire, which is now so called; being of the colour of the heavens or the veins, that is, a sky colour. See xxiv. 10. v. Cantic. 14. iv. Lament. 7.

And a Diamond.] So we rightly translate the Hebrew word Jahalom, which is thought to come from Halam, which fignifies to break. Whence Halmuth is an Hammer or a Maul, v. Judges 26. For the Adamant or Diamond is the hardest of all stones; which breaks them all, but is broken by none, as Abarbinel speaks. It was anciently account-

ed the most precious of all Gems, as Pliny acknowledges L. xxxvii. c. 4.

In the third row, a Ligure.] So we translate the Hebrew word Leschem, which being no where else found, the meaning of it is uncertain. But a great many, both of the ancient and modern, translate it as we do: though what a Ligure is can not easily be refolved. Some think Airiem or Aiseign, to be nothing but the best Amber. But that is no precious stone as all here mentioned are; and therefore (to mention no other conjectures) Braunius thinks we are to understand by this word, a kind of Jacinth; of which there being divers forts, he judges it likely to be that, which nearest approaches to the colour of Amber, which hath made Authors take them for the same. The Ancients indeed commonly by a Jacinth understand a stone of a violet colour, but more pale and dilute than in the Amethyst; and the stone now called an Amethyst, was anciently called a Jacinth. Yet they mention Jacinths of divers other colours, and some shining like fire: vide L. 11. de vest. facr. Hebr. c. 14. n. 11, 12.

An Agate.] So the Hebrew word Schebo, which is no where else mentioned in scripture, is translated by the greatest part of interpreters, who take this for that stone which the Greeks call Achates; which is so well known, that it needs no description; being that beautiful stone which Nature has painted with great variety: from whence it hath got several names, as the same Braunius observes in the same book, cap. 15. n. 4. &c. And the very name of Achates seems to be derived from its various colours: And in Hebrew signifying that which is spotted, as Jacob's cattle were xxx. Gen. 35. Though now, because they are common, they are of no great value: yet anciently it appears from

Theophrastus and Pliny, they were more precious.

And

hearing their unprejudiced judgment of them as Artists, and the judgments of Ladies and Gentlemen, for whose pleasure ART exerts itself, and consulting Authors who have wrote upon such matters, may with some degree of confidence declare, that he has found upon the shores of Lough Neagh and in the neighbourhood of the Lake, not only Crystals and Agates, but Gems also deserving the following denominations, Carnelians, Mocoas, and Pseudo-Adamantes; and at some distance from the Lake, Topazes or Amethysts. And in as much as his principal intention of search was not for these, but for specimens of another class, it may be presumed, that would any person professedly go in quest of Gems on the shores of that Lake, such quantities might be found, as would sufficiently reward the searcher.

It is not long fince there was any value put upon any stones of the production of Great Britain and Ireland, except those of Bristol and Kerry.

And an Amethyst.] The Hebrew word Achlama is no more to be found in the scripture elsewhere, than the two former. But the best and most ancient Authors take it as we do, for that stone which other writers call an Amethyst, which is of a bright violet colour, or like red wine, from whence it hath its name in the Greek. The nearer these stones came to purple, and the more they had of the slame of a Carbuncle, the more precious they were esteemed, as the forenamed Braunius shews L. 11. c. 16. n. 56.

In the fourth row, a Beryl.] The Hebrew word Tharschisch is very variously interpreted; but the LXX, Josephus, and a great many others, take it for that which the Ancients call a Chrysolite; that is, a stone of a golden colour, which others call a Topaz. This Braunius endeavours to prove was the colour of Tharschisch out of x. Dan.

5, 6. v Cant. 14, &c. See c. 17. n. 12, 13, &c.

An Onyx.] The Hebrew word Schoham we meet withal in the beginning of the bible (ii Gen. 12.) and translate it as we do here, an Onyx: But Josephus, St. Hierom, and the Vulgar, translate it Sardonyx; which was of a mix'd colour, of white and red; for the most precious Indian Sardonyx had a radix (as they call it) white, like the nail of one's finger; and the superficies red like blood; and both of them transparent: from whence it had its name; the Sardius stone (as was said before) being red, and the Onyx

A Jasper.] Though the Hebrew name, which is faspeh, be retained among all people to this day, yet all interpreters have not translated it as ours do, who, no doubt, are in the right. For why should we not think Jaspeh is certainly that stone which the Greeks and Latins call Jaspri: As we doubt not the Saphire before mentioned (v. 18.) is the stone they call Saphirus. The best of these stones are of a green colour, like a Smaragdus; but sometimes they have little spots or points in them, of various colours: which hath made some Authors call this stone Panthera. See Braunius, c. 19.

The Bishop of Ely his Comment.

Kerry. The late Countess of Burlington was the first who made those in high life inquire for Pebbles, owing to an accidental circumstance: For her waiting-maid having an honourable amour with a jeweller, and receiving a visit from him, amongst other circumstances of amusement he shewed her some toys of his art, and happening to have amongst them a Pebble, which he took up in his walk, she was so pleased with its appearance, that she requested it might be polished for her; which being soon done, she shewed it to her Lady, who was also pleased so well as to desire that more might be collected for her. This was done, and a beautiful table made of them, placed in a kind of Mosaic work by her Ladyship's direction. This account is given upon the authority of a right reverend Prelate, who had not only a narrative of the matter from the Countess of Burlington; but a present also of an English Pebble set in the cover of a gold box. The same account also results upon the authority of a reverend Dean, who has the honour to be re-

lated to the family.

Of late years pebbles have been of some degree of estimation in this kingdom; and it is about twelve years fince the Inquirer, joining with some Gentlemen in an innocent frolic, to take a house on a bank over the sea, near the harbour of Dublin, for an amusement during a summer, used frequently to collect stones, and fend them to Lapidaries to be polished. Each Gentleman of the party seemed to contend with the rest, for preference in good fortune to find, and judgment to distinguish, what would look most beautiful when improved by mechanic arts: The fuccess of the most fortunate was not at that time of great estimation. But the beauty of that fituation having of later years invited fo many to build country houses for retirement, that the sea shore for two miles is become almost a town, and it is a very general employment to pick up the Pebbles which are most inviting to the fight. Mrs. Heany in particular, a very agreeable wife of a very worthy Clergyman, whole refidence is there, it being her husband's parish, can shew several stones collected there of excellent beauty, but one especially, which is a Carnelian, in which she had an emblematical figure of Liberty cut, and it is set in gold. About the same time also a part of the sea shore, not sifteen miles south from thence, became very famous for beautiful Pebbles. The MUR-RAGH of Wicklow is now so well known in this respect, that it is almost A a 2

almost needless to describe it; yet to foreigners, into whose hands this account of Gems may possibly fall, it may not be disagreeable to have

a few lines bestowed upon it.

From the town of Wicklow, northward towards Dublin, there is an uninterrupted flat country for fix miles along the lea shore, and extending into the main land to different distances; without partitions of fences, till of late years the occupiers regarding husbandry, which requires inclosures, have by building, planting, and fencing, taken in all the flat area, except about the breadth of an hundred yards, which for the length of fix miles remains a smooth surface of beautiful verdure for walking or riding. From the fod, which is a coat of grass upon a mass of mixt matter, consisting more of Pebbles than earth, there is a flope to the lowest water-mark, which is sometimes merely fine sand, fometimes a heap of Pebbles to the height of three or four feet and of considerable breadth. For it seems that one tide shall throw up such a heap, and another tide shall wash them all away: so that particular tides, aided by particular winds, make particular kinds of shores. And as there are a great variety of the former, so are there also of the latter. Hence it is that many persons find their account in searching this shore for such stones as may admit a beautiful polish. For the fea is always furnishing the fearchers with new heaps, or the same one often turned. So many stones of real beauty have been found here of late, that this place has acquired a great fame in this respect; but our Design almost confining us to Lough Neagh, we must return to that.

Having below given such an account of Gems as is sufficient to raise not merely esteem for them, but an affection of a higher Nature, and that upon the authority of a divine law, here shall be given a proof of another kind, and the high regard paid to Gems shall be proved from a falsehood and a mere Imposition. For as Hypocrisy in morals proves the value of true virtue, so do lies and impositions of all kinds prove the value of the real things, they are designed to pass for.

Mr. Carte in the preface to his edition of Thuanus tells us, that of two former editions of that Author's works published with his own allowance, one of them contained the following story, the other not.

"Whilst the King was at Bologna, a stranger, who seemed to be " rough in manners brought a wonderful stone to him from the East " Indies. It was aftonishingly lustrous, and appeared as if it was al-" together fire, and emitting a confiderable quantity of rays on all sides, " was hardly to be born by human fight. Another wonderful circum-" stance of it was, that if it was buried in the earth, it would by its " own virtue break forth from its confinement with violence: It could " not be contained or included in any narrow space; but seemed to " delight in open and free space only. It had the most perfect purity and " splendor, without any, even the least stain of foulness. It had no cer-" tain figure but was variable, and that instantaneously: and in as much " as it was extremely beautiful to behold, it raised a desire in specta-" tors to handle it, which yet it would not fuffer with impunity; and " if some more resolute than others attempted to handle it, they suf-" fered pain by it; this many persons tried in the presence of many. If " any part, by the more obstinate attempt of persons to handle it, was " taken off (for it was not very hard) it did not thereby become less. "The stranger said, the virtue of this Gem was useful in many re-" spects, but peculiarly necessary for Kings; but this he would not re-" veal without a confiderable reward. *"

This

* In fine prioris tomi Drouartiani mira de lapide Indico legitur narratio, quæ in Patef-

foniano volumine non comparet. Verba ita se habent. P. 453, I. 3. Post exolvit adde. Dum Rex Bononiæ esset, allatus est ad eum ex India orientali, ab homine incognito, fed, ut apparebat, moribus barbaro, lapis stupenda specie et natura, videlicet lumine et fulgore, mirabiliter corufcantibus, quique totus velut ardens incredibili splendore micabat, et jactis quoquo versus radiis, ambientem aerem luce nullis fere oculis tolerabili latissime complebat. Erat et in eo mirabile quod terræ impatientissimus, si cooperiretur, sua sponte et vi, sacto impetu, confestim evolabat in sublime; contineri vero includive ullo loco angusto nulla hominum arte poterat, sed ampla liberaque loca duntaxat amare videbatur. Summa in eo puritas, eximius nitor, nulla forde aut labe conquinatus. Figuræ species nulla ei certa sed inconstans at momento commutabilis, cumque esset aspectu longe pulcherrimus, contrectari tamen sese impune non patiebatur, et diutius contra adnitentibus, aut obstinatius cum eo agentibus incommodum afferebat; quod multi, multis spectantibus sunt experti. Si quid fortassis eo enixius conando detrahebatur, nam durus admodum non erat, nihilo minor fiebat. Hujus virtutem ac vim esse ad quam plurima cum utilem, tum præcipue regibus necessariam, aiebat hospes, qui miraculum ostentabat, sed quam revelaturus non esset, nisi ingenti pretio prius accepto. Hæc ut in literis Jo. Pipin occulati rei testis, qui in familia A. Momorantii M. E. medicinam faciebat, ad Ant. Mizaldum, et ipsum insignem medicum pridie ascen-

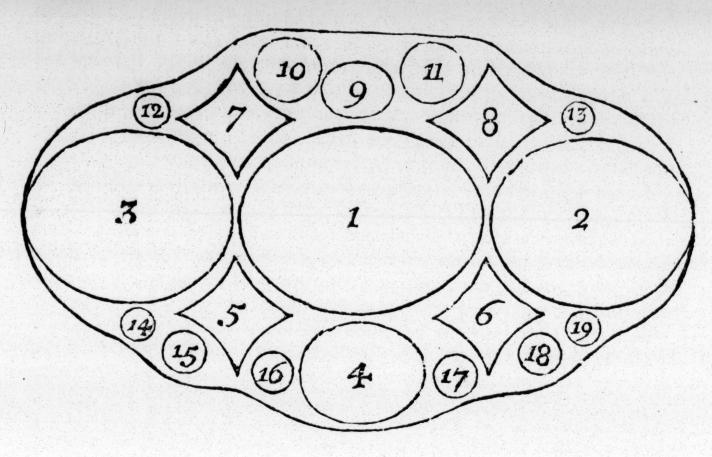
This account has more the appearance of a riddle than a true history, and if an artful man could convey some of the Linster coal of this Kingdom which does not smoak, to a person in a country where pitcoal is unknown, as it is said, English coal is shewn in the collection of the Duke of Tuscany as a Rarity, the riddle may be explained by burning it. But the only use that shall be made of this story is, that whereas the ingenious relator has left it out of one of the editions published by him, it is likely, he found he was grossly imposed upon: and therefore all persons of Natural Inquiry should be very cautious in believing reports, and should relate sew things of which they have not sensible evidence. The present Inquirer means to observe this caution in what he

is about to relate concerning the Gems of Lough Neagh.

The natural appearance of all the Gems found at Lough Neagh are already described Lect. 3. from N. cclxvii. to N. cclxxi. There was one found about fifteen miles from the Lake, which deserves a description also. It was a transparent coloured stone, with an hexangular column and pyramid, of no great beauty in its natural state, but extremely beautiful when polished. It was large enough to have made a triangular seal of a common size, but the Artist breaking it, in order to see whether it was worth labour, found it of a pure texture, hardness, and homogene appearance, and polished each fragment into one form of different fizes, for Itones for rings. It is the colour of Burgundy in many views, and yet in particular lights it has more or less of that and fome other colours; so that different spectators give it different names: some classing it with the Amethyst, some with the Topaz, all allowing it to be beautiful. The Amethyst signifying a Grape of the colour of red wine as well as a Gem, feems to have the best title to give a Name to this Gem. The Inquirer has of this kind one that weighs above three ounces, but being foul does not merit a description. And whereas the pure Amethyst was polished into the form of Diamond-cut stones, one of these is set in gold along with some sparks of the Pseudo-Adamas in trefoil, and is a beautiful ring in the custody of Mrs. Elinor Barton, the Inquirer's fifter-in-law, who rates it at an high degree, perhaps

sionis Bononiæ datis, perscripta sunt, ita trado, et amplius discutienda physiologis relinquo: Nam veteribus, qui de rebus hujusmodi scripserunt, similis lapis necne cognitus suerit, nec Pipinus iis literis, se scire dicit, nec ipse assirmaverim.

perhaps above the value, upon account of perfonal regard to the Donor.



The figure prefixt to this part of the Lecture represents a design which the Inquirer is about executing, that is, to have specimens of the several kinds of Gems and Agates of his finding, set in the form represented there, being the lid of a large box, of sufficient depth to contain many others of the same kind within. Having as yet gone little further in polishing than those designed for the lid, sew else shall be desirbed here.

N. 1. is part of a Carnelian described N. celxx. Lect. 3. It is evidently two stones naturally adhering so as to answer the purposes of firm continuity, there having been a third of the same denomination adhering to the star surface of one of these, which, when the Artist was desired to break it transversely towards one End, in order to discover how far a visible line which appeared like a slaw penetrated, separated from the rest of the mass, with a most equal smooth slat surface. This piece being of a larger diameter than the rest, and of an oval form, was immediately polished for a top to a snuff-box. The polish of it is exceeding sine,

and it partakes of the nature of a red Carnelian in one part, and of a yellow in another. It is in the custody of Mrs. Delany, Lady to the worthy and learned Dean of Down, whose approbation might be sufficient foundation for fixing a value upon this and many other things, being one, who has joined all the judgment of one sex to the delicacy and fancy of the other, that it is not easy to say, whether her mind conceives the beauties of Nature, with most readiness and propriety, or her hands execute with the pencil her excellent imaginations with the most skill.

The remaining part of the Carnelian, being as has been faid a double stone, is polished also into an oval form for the top of a box, but is left thicker than usual. It has a representation of what painters call a Glory in one part, when held between the spectator and the light. N. B. Most part of the appearance of raw sless been said a double stone of the spectator.

natural state, was ground away in the polishing.

N. 2. is a Mocoa stone in a polished state, which is described N. cclxix. in a natural state. It is polished into a form nearly oval for the top of a box. It is extremely hard, smooth and transparent, but not equally so, having in some places a cloud which is rather a beauty than deformity, and in one place particularly has a fair representation of a wind-mill in it (b). Some parts of the large mass had Dendrites in them: Therefore this stone should be called a Mocoa.

N. 3. is a most beautiful Agate, polished into the same form for the same use, transparent in the thin part only. It is a congeries of several fragments of Agate cemented by a hard matter, but not so hard as the Agate itself, which being in a small quantity in proportion to the matter cemented, does not hinder the whole mass to take a charming polish.—The colour of the fragments of Agate is chesnut, the colour of the cement inclines to white: Of this and the Mocoa mentioned Mr. Penjamin Barton has sets of sleeve buttons, which he esteems highly, perhaps with a good degree of brotherly affection above the mere value of the stones.

N. 4.

⁽b) Another part of this mass has a beautiful representation of a sheet of water; a third has that of an honey comb; a fourth has that of a crescent, or half moon: The colour of the stone is in some places that of Champagne, in others it is somewhat milky.

N. 4. is a black Agate, with some white, which affords a whimsical figure, that of a Capuchin, with hood, cap, eyes, nose, mouth, chin, and hands lifted up, fairly represented: This therefore we will call the Capuchin Agate.

N. 5, 6, 7, 8, are different kinds of Agates all beautiful, yet not

eafily admitting particular descriptions.

N. 9. is a piece of the Topaz or rather Amethyst already described

in this Lecture.

N. 10, 11, 16, 17, are pieces of the mass of Pseudo-Adamas described N. celxvii. and mentioned in other places of these Lectures. This extraordinary mass, in being rolled ashore by the agitation of the water in some storm, which tore it from its place of growth, received some cracks, which gave occasion to break it into different blocks, out of which are made several ornamental things, particularly sleeve buttons, seals of different forms, triangular, pyramidal, &c. and one diamond-cut mass weighing one quarter of an ounce, of an exceeding sine water. Another of the same form but much larger, weighing one ounce and sisteen grains brilliant-cut, in order to be a model of the samous Diamond which goes under the denomination of Pits. It is not easy to describe the beauty of this stone, and therefore we shall leave it to others who have seen it, and admired it, to speak of it as they think proper.

The Pseudo Adamas described N. cclxviii. is polished into a form for a seal of a large size, and is a fine Gem, in the custody of Mrs. L. Bush; a Lady of whose skill in drawing there is a proof exhibited in the frontispiece of this Book; but if her volume of Perspective Views were laid before the Curious, our country would reap so much credit by it, that its not being done is matter of concern to all who know the value of them. If an Inquirer into Nature could represent the occult phænomena, as truly, as this Lady can the beauties of the visible world, his personmence must please the judgment as much, as hers do both judg-

ment and fancy.

The rest of the stones numbered in the lid of the box mentioned, are different kinds of Pebbles, which tho' extremely beautiful can not easily be expressed to purpose in words, so as to give that information to the imagination, which should make it worth while to attempt it. But as a recommendation of the value of some of them, John Stear, Esq; of

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the county of Meath, a Gentleman of real worth and discernment in many things of value, has a set of sleeve buttons of one kind of them; and other Gentlemen have of other kinds: All which are esteemed. Besides these, there are many stones not yet polished in the collection, and which therefore can not be described here. The Printer and Bookseller hereof have specimens of some of these Gems set in gold, which are worth notice; but the masses from which they were cut being described need not be mentioned again. Our History of Irish Gems might perhaps be inlarged, if the Reverend John Payne, a very worthy Clergyman, was near at hand, to give information to his acquaintance in what he has discovered in this respect: This Gentleman deserves to be known in more kingdoms than one, by those to whom ingenuity is a recommendation. It is as possible for men of worth to lie hid in the world, as for Gems to lie concealed on the shores of a Lake.

This account, although of few specimens, being the first attempt of the kind to raise an expectation to find Gems of estimation in Ireland, it is hoped that others will be encouraged to search for more, and that all persons will esteem their searches. For the excellent Historian of the Royal Society observes: There is a reverence due to the first trials and intentions, as well as to the last

ACCOMPLISHMENTS OF GENEROUS ATTEMPTS.

Having thus described the mechanic forms and uses of our Gems, some reasoning must be bestowed upon the natural production of them, especially since a long prevailing opinion concerning them has been sound weak. Crystal being the basis of almost all the admired Gems, its generation should in the first place be accounted for. You are here requested to bear in mind, what has been already laid before you, concerning the Petrisications of Lough Neagh, to wit, that so many of the specimens have such plentiful indications of crystalline matter in them, that it is a fair presumption; that they all are principally wood metamorphosed by that sort of matter, and that crystalline effluvias abound in most parts of this Lake, and also in its neighbourhood. But not to come too quick upon a Solution of a phænomenon well worth attention and a methodical process, hear first the introduction of Schuitzer, when he is about to speak of this matter, in the account of his journey (c) through

through the Alps, which have had hitherto the greatest fame for these productions, but it is hoped some other places are likely to be found

as well deserving a reputation in this respect.

Nunc ordo rerum in hoc Sancti Gotthardi cacumine peragendarum me ducit ad χευταλλο-γεαφίαν, rem ut curiosissimam, ita difficillimam, quæ ingenia subtilissimorum etiam philosophorum ita torsit, ut ad hanc usque diem sese ex variarum rerum circa hanc materiam occurrentium labyrinthis extricare non potuerint — Trahit patria lapidibus his vel gemmis nativa hoc certum est quo altiore loco eruantur crystalli, eo quoque majores illas esse puriores et pretiosiores. Schuitzer has not given the weight or fize of any Crystal in his catalogue of curious Crystals. Doctor Woodward mentions one under the character of very large, Cat. Eng. foff. 2 part p. 158. in these words: "A single column or shoot of Crystal very large, being 3 inches in length, and 1½ in diameter near the base. Yet this Crystal was not above one fourth part of the mass that was found on the shore of Lough Neagh, weighing two pounds two ounces. The shapes of the surfaces are given in Plate 6. fronting Lect V. Fig. 5. in a small scale: And whereas there are thirteen surfaces delineated, it should be considered as a Crystal of six surfaces in the column and fix in the pyramidal part. For the base where it adhered to This Crystal having a the rock is delineated as one of the furfaces. crack almost half through the body of it, it was necessary to break it; and in order to do this, the Artist taking it in one hand, and striking it with a wooden mallet in the other; he was obliged to give above a score strokes, before he broke it: Out of one of the fragments, which was cut by means of emery and a plate of metal turned by a wheel, there was an intention to have had the exact model of the Diamond called by the name of Pits, which, they fay, was fold to the King of France for 120000 l. but it exceeded that in fize and is a charming stone, weighing an ounce and fifteen grains. Its lustre is very considerable, and the hardness (which is always proportional to it in pure stones) exceeding any that have been polished in this kingdom. The rest of the fragments were intended for spectacles, and plates, to cover enamelled pictures. A much larger Crystal than this was found some years past in the county of Antrim, in the hill called Knockclaid near Ballycastle. A Pea-Sant spying it, where a torrent had washed away the earth, that incom-B b 2 pailed

passed it in its native bed, took it home, and his pleasure of view soon palling, he carelessly made use of it in building a fort of a wall, to keep cattle from his garden: A Gentleman who was hunting, having occasion. to have part of that wall thrown down, was struck with the glistening appearance of this stone, and purchasing it for a very small price, he took it to London and fold it at a greater. The weight of the Crystal was thirty pounds (d). He referred some chips, which he had polished into forms for his own use; but what estimation they have with him and others, the Inquirer will not take upon him to lay, not having an opportunity of speaking to the Gentleman himself concerning it; yet as much as is related he can vouch upon the authority of a very worthy Clergyman (e). The defign of mentioning this is principally upon account of the weight: Could the hardness, lustre and value of it be also accurately told, it would answer another purpose, in regard to the remark made by Schuitzer: Hoc certum est quo altiore loco eruantur crystalli, eo quoque majores illas esse puriores et pretiosiores. Some crystals found on the shores of Lough Neagh mentioned above, are better than the Crystals, which are polished and fold here under the title of the Crystals of Geneva: Yet the native bed of the large Crystal was in all probability under the water of the Lake, and being torn from the rock to which it adhered, was rolled ashore in some storm, and therefore though a very pure Crystal, it suffered damage in its journey, which made it necessary to break it, before it could be determined, which was the most prudent manner to cut it, to make it answer the best uses. The finding of this specimen, and trying it by the rules of Mechanic Arts prove two things, first, the weakness of Pliny's opinion (Glaciemque esse certum est (f)). For

(d) Magnitudo ampliffima adhuc visa (Crystalli) nobis erat quem in capitolio Livia Augusta dicaverat librarum circiter quinquaginta. Plin. N. H.

(e) The reverend archdeac n B yd, brother to a Gentleman to whom the public owes a great deal, for his excellent works at Ballycastle: Posterity will acknowledge it if the present age does not.

(f) Non alibi certe reperitur, quam ubi maximæ Hibernæ nives rigent, glaciemque esse certum est—non reperitur in aquosis quanquam in regione prægelida, vel si ad vada usque glacientur; cœlesti humore parvâque nive id sieri necesse est ideo caloris impatiens. Nat. hist. 1. 37. c. 2. Every remark here is shewn to be weak by the production of Crystals.

For the production of Crystals in a country, where frost has very little influence, and in the bottom perhaps of a Lake, where the keenest cold, was the climate subject to it, would scarce reach, is sufficient to shew the weakness of his opinion, that Crystals are ice hardened;

Crystals in Lough Neagh, and experiments upon Crystals mentioned elsewhere in these Lectures *.

* One circumstance especially, that of intense cold being thought necessary to the production of Crystals, has been an error of old date. There is no country so free from intense cold as Ireland. Even in England which is colder than Ireland, most of the frosts that occurred in almanacs, and histories, are as follow. 1076 A frost from the beginning of November to the middle of April. Rapin's hift. fol. Vol. I. p. 181. Note 17. 1517 A great frost; carts passed over the Thames from Westminster to Lambeth, page 737. N. 2.—1607 A great frost. Dove's almanack.—1642 A great frost.— In an old almanack of Pelletrin for 1642, we read in the table of memorable things, Since the blazing star and frosty winter 70 years, that is, in 1572 there was so remarkable a frost as to make it worth notice 70 years after. ——1683 The winter this year was very remarkable for a violent frost which began about the beginning of December, and lasted till the 5th of February. The Thames was so frozen, that there was another city as it were on the ice, by the great number of booths erected between the Temple and Southwark, in which place was held an absolute Fair, for above a fortnight, of all forts of trades. An ox was likewise roasted whole, bulls baited, and such like.—There was a great frost before this in 1607, and another since, in 1739-40. This last being in our memory and observation, seems to have exceeded all those mentioned in history. The Thames was at that time a most horrid spectacle. For the frost coming on with a most violent and keen wind, in fo much that feveral travellers were frozen to death the night in which it began: The quantity of ice made in the Thames being broken by the tide, into large and irregular fragments, floated backwards and forwards with a motion that excited horror, and being interrupted by the bridge at London, was raised on one side into a pile that equalled the highest battlement; and the whole surface being fixed in a frozen state the night following, continued so, near three months: To look upon the Thames metamorphosed into frozen Alps was terrible and shocking, and more so, to see forty thousand watermen turned out of their element and begging with mourning boats, which they carried through the streets. By this frost Lough Neagh also was frozen over, which being mentioned in other parts of these Lectures, there is no occasion for repetitions. Let it suffice to observe, that the surface of the Lake was smooth, and afforded excellent travelling to horse and foot, from one county to another, without any account of unfrozen parts which might be attributed to springs, upon any authority that can be depended upon †. The Inquirer being then in London, could not make ob-

+ It is probable if there were many such, some misfortune would have happened to travellers, who by falling into them might give occasion to their being spoken of and remembered.

if it was not already done by what is said in the demonstration of proposition 10. Lect. 2. For since one certain degree of heat dissolves all kinds of ice, Crystals would be capable of that dissolution, were they nothing but hardened water: whereas by experiments Lect. 3. the greatest heat of an air surnace is not capable of making any other alteration than that of colour and brittleness, in a small degree (g).

But to come directly to the main point, and to affign the physical cause of the crystalline bodies sound in and about Lough Neagh; let the account of the extraordinary specimen N. celxi. of Lecture III. be referred to in particular as well as most of the specimens described, and also what is said in the historical Lecture. It appears from all these laid together that a crystalline effluvia ascending in different parts of the mix'd area of waterand land, which is the extent of the inquiry intended to be laid before you, being about thirty miles diameter, near half of which at least may be supposed to be water, that a crystalline

fervations upon the Lake in this respect. If every frost mentioned above had the same effect in Ireland (whose records say nothing of them) yet it is not likely they should produce Crystals according to Pliny's hypothesis: For if the almost perpetual freezing in the Alps be the cause of Crystals there; the sew frosts mentioned in the course of 700 years can not well be supposed to produce them here. Besides, if freezing be the cause, it should seem the keenest would make the hardest and best; but the Crystal sound in Lough Neagh weighing two pound two ounces is much harder than those brought from Geneva; and the lustre is also superior: For this reason it is not improper to call it a Pseudo-Adamas.

(g) Before the physical cause of the production of Crystals be affigured, which immediately follows in the text, it may not be improper to lay before you Doctor Woodward's account of Crystals, as quoted by Schuitzer, together with some observations made in Kerry by the Inquirer.

Dignoscantur facile crystalli forma corpora in fissuris perpendicularibus reperta, ab illis, quæ in ipsis stratis sunt locata. Prioris generis crystalli non carent sua radice (ita vocant rei gemmariæ periti abruptæ crystalli vestigium, quo mediante lapidibus vel sisuræ parietibus adhæsit) quæ inveniuntur in terreis, arenosis, aliisque id genus stratis, undique sunt solutæ, et pro in integræ, nullo apparente cohæsionis indicio *. Quæ vero immerguntur ipsis lapidum marmorum vel alius solidioris materiæ stratis, dissiculter admodum separantur ab his, quoniam undique circumdantur, vel si solvantur, abruptionis vestigia ex omni parte ostendunt: disserunt adeo ab illis, quæ in perpendicularibus intervallis occurrunt, quod hæ, uti jam annotavimus, ex una duntaxat parte adhæsionis indicia exhibent.

In Kerry, Crystals are found in another manner than any mentioned by Schultzer as quoting Doctor Woodward. For the Inquirer has had them dug in the mountains, and found some of them in the first earth turned up by the spade; in this earth were very sew stones of any kind, and none to which the Crystals adhered; they might be pick'd out of the earth with seemingly torn roots *, yet not adhering to any hard mat-

crystalline effluvia is producing phænomena of very different visible appearances (b). For in the fame mass, particularly N. celxi. there is foul crystal, coarse stone, and mere wood all continuous: the original body was wood alone, which falling into this bed of metamorphofis, received the effluvia differently according to the difference of its pores, and retained them according to different degrees of attraction; fo as to form a specimen of various matter. Where the effluvia meets with no foul matter in its journey upwards, it may perhaps form a pure Crystal, or Pseudo-Adamas adhering to some rock, such as is deseribed N. cclxvii. where it meets with metalline matter, from which it receives a tineture it may form coloured Gems, fuch as Topazes and Amethysts, as mentioned in the beginning of this Lecture. Or if it meets with fulphur it may receive a tincture more casily, than in the dense form of hardened Crystal, as in the experiment mentioned page 107. where the Crystals of the north and fouth of this kingdom being put under the torture of intense heat suffered a little alteration in colour, reasonably attributed to sulphur which had been undesignedly left in the crucible; whether a less degree of heat would not have caused this, the artists can tell, who know how to change the colours of many natural stones; perhaps a much less heat would do, because it would not

ter. Most of these Crystals were pure and transparent throughout: whereas those which adhere to rocks are for the most part muddy and opaque towards the root. Deeper than twice the depth of a spade, beds of Crystals were sometimes found, where they adhered in great abundance to stones of various sizes from five to fifty pound weight; which stones seemed to be a soul mixture of opaque matter along with crystalline matter. There were Crystals with two pyramids to one column, being formed without any seeming adhesion to any thing, some double columns with pyramids to each, and both columns ragged at the other end, and some double pyramids placed base to base without any column.

answer their purpose to make them brittle, as it seems an intense heat

(b) If any one still concerts that Crystals are water hardened, it will puzzle him prodigiously to account for the figures of them, and the position. For they shoot into one another, so as to penetrate half a pyramid, or passing through, to be incompassed by other Crystals; they shoot perpendicularly upright, contrary to the nature of water, which is to form stalactites in a pendant posture: Recollecting what has been said, and viewing only one mass of Crystals formed in this intangled manner, may suffice to convince any one of the weakness of such an opinion: But the essure along with nature in chymical processes, is capable of producing so many phænomena with salts not totally dissimilar from the formation of Crystals.

does. A Gentleman of ingenuity acquainted the Inquirer of a change of the colour in the stones of a buckle, with some surprize, in the sollowing language, "I certify that since the year 1745 having worn a buckle in my neck, set with forty colourless transparent Crystals, I found in a short time they acquired colours, first a yellowish Topaz, then sine Emerald green colour. Eight are in the latter state, two in the former, and six in an intermediate state of colouring, the rest though at present colourless, I expect, will change."

This Gentleman's opinion was, that the stones really acquired colours; but the Inquirer having them examined by an artist, it appeared, that the stones were as colourless as ever, but a green foil had grown under them which gave a beautiful colour to some of them. The cause of this perhaps may be the oil which is used in wigs, infinuating into the cavities of the fockets, in which the stones lay, the setting not being perhaps quite as accurate as it ought to be, and the buckle being worn on the neck. For it feems these settings are commonly in metal below sterling, which has a mixture of copper or brais, which is capable of a green ærugo. In fix years time therefore those phænomena might be produced. Artists however have a method of changing the colours of many precious stones, as well as imitating their substance by pastes. These mysteries being only known to themselves are not to be explained here. It is sufficient at present to assign a general cause, to wit, a crystalline effluvia; and when future searches give a larger scope of observation, particular productions may be explained by particular kinds of matter. in different apartments of the earth mixing with this common vehicle. Where the crystalline effluvia ascends freely and purely it forms pure Crystal, and in particular cases coalescing into exceeding hard masses may deserve a name of a particular kind of Gem, tho' less excellent than a Diamond, yet more so, than those, which here pass under the names of Bristol, Geneva, and Kerry stones; when the effluvia meets with strata of matter from whence it acquires a brown tincture, it forms the brown and brittle Crystals of Cranfield, described in Lecture V: when it meets with coarser matter, it forms coarser masses scarce distinguishable from common stone; of which there are many specimens at the place just mentioned; the transparent Crystals growing between rocks,

rocks, which seem to be masses of the same matter rendered coarser by an intermixture of coarser matter.

As to the quick generation of Crystal; the opinion generally prevalent in the neighbourhood of Cranfield spring is, that it grows in a night's time, particularly the first of May. For the people alledge that if the well be emptied on May eve and the Crystals be all swept away, there will be found next morning a confiderable quantity of them, which grew in that time. The INQUIRER is very well inclined to think that their growth is quick in that place, because within about two miles of the well, where they are found in great plenty close upon the Lake, so as to be covered by the water of it in winter time, and lie in the crevices of a kind of rock, capable of being broken with a common spade; he observed them also growing in the thin sod which lay above the rock towards the skirt of the land, and which fod had all the appearance imaginable of a very late generation: But having never had time freely at command, he could not allow himfelf to stay, to make observations sufficient to this purpose. But the Gentlemen in the neighbourhood may perhaps from these hints be induced to make observations which may perhaps ascertain the matter.

CONCLUSION.

Longæ chartæque viæque finis.

AVING thus finished our book and journey, for so it may be called, seeing that a man may travel as much space by moving in a circle round a Lake, as in a direct line to Grand Cairo, there is some joy arises, which itself alone may be called a fort of reward. The traveller wishes to tell his story, and when he has told it, to be credited. The Inquirer has told his story, but what credit it may have with the reader, he waits to know. If any reasonable objections occur, which shall be offered with good manners, a reply shall be made with the same courtesy, or not at all. If any persons through petulance object without reason, the Inquirer is prepared—not to answer, but to—bear. He meaned well in his searches, and also in the publication;

cation. If the account be not executed as fully and correctly as the fubject requires, let some other person prosecute it to better effect: For it is not offered as a compleat history of that Lake, which has more materials for a natural history than any area either of land or water of the same dimensions, which the Inquirer has ever been acquainted with. It is larger than the ille of Barbados, which lately afforded a natural history in folio. at one guinea, and one and an half subscription, with near one thoufand subscribers, and was written by a Clergyman. Natural philosophy therefore is a part of knowledge highly rated, as it ought to be, and not unbecoming one whole principal occupation should be the study of the divine law. For is not this divine law written in the book of nature as well as revelation? Is one intelligible without the other? Do not the most eminent artists in painting, some where mark a signature, whereby they mean to be known; yet to find which costs the spectator fometimes much pains? Is not the divine fignature in this manner painted in every phænomenon, but observed only by the studious? The great Newton concludes his book of nature, with the attributes of the Deity drawn from nature: The Inquirer would do the fame, was he equally acquainted with the volume of the natural world. But one glorious circumstance of religion is, that it consists more of the honesty of the heart, than the fagacity of the mind; what is not in every man's capacity to comprehend, may yet be a proper subject of faith to an honest judgment; and a good man may subscribe to a creed, which he could not indite. The best writers in defence of religion have been those, who were best acquainted with the power of God in the natural world. The first lectures published in consequence of the religious endowment of the honourable Mr. Boyle, are the best of all those which bear that denomination, and are the application of natural philosophy, particularly that of Sir Isaac Newton, to theology. The union of these two studies is what the Inquirer wishes to see supported, and his small labours shall be hereafter, as they have been heretofore, directed to this end.

Soli DEO GLORIA.

N. B. The number on this page has the number of the pages in the address and subscribers names included in it. An index is not deemed necessary to this book, the title pages of the Lectures in a great

measure answering that purpole.

Note also, that Mr. Henry Wray of this city, brother to the gentleman, who found the large Crystal mentioned page 178, near Ballycastle in the north of Ireland, weighing thirty pounds, is ready to attest the goodness of it; having a triangular seal of part of it, with his arms cut on it, also part of it in a ring, which has frequently been taken for a Diamond; the lapidary assuring him that it came nearest to the hardness of a Diamond of any Crystal he ever cut.

ERRATA.

Page 63 for CLII. read CLIII.
Page 65 for CCIV. read CCLIV.
Line 9 page 130 for a necessity read no necessity.



Just published by the Author in quarto, price a British sixpence, fit to be bound along with this book, and sold by G. and A. Ewing and other booksellers,

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Towards a full description of

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A. DIALOGUE

CONCERNING

Some things of importance to Ireland;

Particularly the county of Ardmagh; dedicated to his grace GEORGE Lord Archbishop of Ardmagh, Primate of all Ireland, and one of the Lords Justices of the kingdom.

N. B. The analogy of divine wisdom in the material, sensitive, moral, civil and spiritual system of things, printed in Dublin 1750, being almost sold, that is, above one thousand of one thousand and sifty copies; the Author means to publish another edition of it (which will be the fourth edition, reckoning those in London) with the addition of sour entire discourses, and also additions to many parts of those discourses already published. It is hoped the public will give encouragement to print this book, without the trouble of solliciting subscriptions; the design being to print it as cheap, as use and beauty will allow. The additions, if possible, shall be printed separately for the use of the first purchasers.

